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FORMERLY PROFESSOR OF ANATOMY IN JEFFERSON MEDICAL COLLEGE;

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WILLIAM H. PANCOAST,

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PREFACE.

THIS book contains the complete text of my two Compends of Anatomy, namely—the "Human Anatomy," and the "Visceral Anatomy," heretofore published as separate volumes in this series of students' manuals. The marked favor with which these Compends were first received, some three and a half years ago, has since been continuously extended to them by teachers and students, both in America and in England. This has been manifested by the sale of a new and large edition every year, and has been extremely gratifying to the author. Upon the exhaustion of the third edition, the publishers resolved to acknowledge the universal appreciation shown these books, by incorporating the two in one volume; making this, the first of the now well-known "Quiz-Compends," a complete quiz-book on Human Anatomy. In carrying out this generous resolution, the original matter has not been curtailed anywhere; but, on the contrary, much new matter has been introduced wherever greater detail seemed to be desirable, and the number of the illustrations has been increased by eighteen new cuts.

Originally designed for the use of the medical student, in preparing for the exercises of the quiz-room and for his final examination, the text is confined to the essentials of each structure treated of, which are arranged in such a manner as to facilitate their rapid acquirement. All superfluities of description have been studiously avoided, and only such matter inserted as should be thoroughly known in order to pass a rigid examination on any organ or structure of the human body. The descriptions will be found to closely follow Gray, though Quain and other recognized authorities have been freely consulted during the preparation of the text. For many of the special arrangements

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POTTER.

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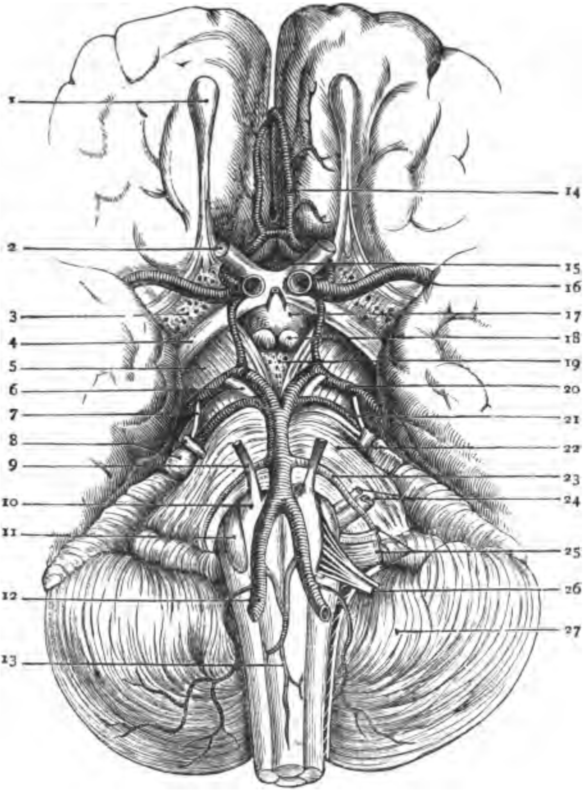


THE BASE OF THE BRAIN.

1. Olfactory Bulb. 2. Second, or Optic Nerves. 3. Anterior Perforated Space. 4. Optic Tract. 5. Crus Cerebri. 6. 3d Nerve. 7. 4th Nerve. 8. 5th Nerve. 9. 6th Nerve. 10. Pyramid. 11. Olivary Body. 12. Vertebral Artery. 13. Anterior Spinal Artery. 14. Anterior Cerebral Artery. 15. Lamina Cinerea. 16. Middle Cerebral Artery. 17. Tuber Cinereum. 18. Corpora Albicantia. 19. Middle Perforated Space. 20. Posterior Cerebral Artery. 21. Superior Cerebral Artery. 22. Pons Varolii. 23. Inferior Cerebellar Artery. 24. 7th and 8th Nerves. 25. 9th, 10th and 11th Nerves. 26. 12th Nerve. 27. Cerebellum.

A

COMPEND OF ANATOMY.

Define the term Anatomy. Derived from the Greek ἀνα *ana*, through, and τέμνειν *temnein*, to cut, it strictly means *dissection*, but is technically applied to that science which treats of the structure of organized bodies.

What are the divisions of Descriptive Human Anatomy? They are,—*Osteology*, the anatomy of the bones; *Syndesmology*, of the joints; *Myology*, of the muscles; *Angiology*, of the vessels; *Neurology*, of the nerves; *Splanchnology*, of the internal viscera; *Adenology*, of the glands; *Dermatology*, of the skin; *Genesiology*, of the generative organs.

State the number of Bones in the Adult Human Skeleton. It is variously stated by different anatomists. Excluding the teeth, the Wormian and sesamoid bones, and the ossicles of the middle ear, the whole number would be 200; excluding also the 2 patellæ, and the hyoid bone, would leave in the skeleton proper 197 bones.

Describe the Long Bones. They number 90, act as supports, or levers, and are known by having a medullary canal in the centre of each, a shaft (*diaphysis*), and two extremities. They are developed by osseous deposit in cartilage.

Describe the Short Bones. Numbering 30, they are found where strength is required, but limited motion. They also are developed by osseous deposit in cartilage.

Describe the Flat Bones. They number 38, protect the viscera by forming walls around them, and afford extensive attachment for muscles. They are developed by osseous deposit in membranes, and consists of 2 dense layers, separated by a cellular or cancellated osseous tissue, the diploë.

What are the Irregular Bones? They are 39 in number, and include the vertebræ, sacrum, coccyx, the temporal, ethmoid, and sphenoid bones, and the bones of the face, except the *nasal*, *lachrymal*, and *vomer*.

Name the Bones of the Head. They number 22, and comprise the—

Cranial Bones (8)—the frontal, 2 parietal, occipital, 2 temporal, the sphenoid and the ethmoid bones.

Facial Bones (14)—2 superior maxillary, 2 malar, 2 nasal, 2 lachrymal, 2 palate, 2 inferior turbinated, vomer and inferior maxillary.

Name the Bones of the Trunk. They number 53, as follows, viz.—

Vertebræ (24)—7 cervical, 12 dorsal, and 5 lumbar vertebræ.

Thorax (25)—7 pairs of true ribs, 3 pairs of false ribs, 2 pairs of floating ribs, (articulating with the bodies of the dorsal vertebræ,) and the sternum.

Pelvis (4)—the sacrum, the coccyx, and 2 ossa innominata; each os innominatum consisting of 3,—the ilium, ischium, and pubes.

Name the Bones of each Upper Extremity. They number 32, as follows:—

Shoulder (2)—the clavicle and scapula.

Arm (1)—the humerus.

Forearm (2)—the radius and ulna.

Hand (27)—8 carpal bones,—the scaphoid, semilunar, cuneiform, pisiform, trapezium, trapezoid, os magnum, and unciform,—5 metacarpal, and 14 phalanges.

Name the Bones of each Lower Extremity. They number 29, viz.—

Thigh (1)—the femur.

Leg (2)—the tibia and fibula.

Foot (26)—7 tarsal bones,—the astragalus, os calcis, scaphoid, cuboid, external middle and internal cuneiform,—5 metatarsal, 14 phalanges.

Name the Unclassified Bones. They are the—

Patellæ (2), which are sesamoid bones, each developed in the tendon of the quadriceps extensor femoris muscle.

Hyoid Bone (1)—the tongue-bone, not articulated to the skeleton.

Malleus, Incus, Stapes (3 pairs)—the bones of the middle ear.

Sesamoid Bones, of variable number, situated in the tendons of the gastrocnemius and peroneus longus muscles, and in the flexor tendons of the great toe and the thumb.

Wormian Bones (ossa triqueta), sometimes found in the cranial sutures, are not constant in number or size.

Name the principal Eminences on Bones. *Heads*, are convex and smooth, for articulation in movable joints. *Condyles*, are irregularly-shaped heads. *Trochanters*, when for turning the bone. *Tuberosities*, are broad, uneven prominences. *Tubercles*, are small tuberosities. *Spines*, or *Spinous processes*, when sharp and slender. *Apophysis*, is a process which has been an

Epiphysis, or separated from the shaft by cartilage, but has become united thereto by ossification.

What other names are given to Bony Prominences? There are several adjectives applied to them from their fancied resemblances, such as—*Azygos*, without a fellow; *Clinoid*, like a bed; *Coracoid*, like a crow's beak; *Coronoid*, like a crown; *Hamular*, hook-like; *Malleolar*, like a mallet; *Mastoid*, like a nipple; *Odontoid*, tooth-like; *Pterygoid*, wing-like; *Rostrum*, a beak; *Spinous*, thorn-like; *Styloid*, pen-like; *Squamous*, scaly; *Vaginal*, ensheathing, etc.

Name the Cavities of Bones. Articular cavities are called *Cotyloid*, cup-like; *Glenoid*, shallow; *Trochlear*, pulley-like; *Facet*, if smooth; *Alveolar*, or *Alveoli*, when socket-like. Non-articular cavities are named fossæ, sinuses, aqueducts, foramina, canals, fissures, notches, cells, grooves, depressions, etc.

What is the Composition of Bone? *Organic* or animal matter, about ⅓, consisting of gelatin, vessels and fat. *Inorganic*, or mineral, about ⅔, consisting of phosphate and carbonate of calcium (62⅓ per cent.), with fluoride of calcium, phosphates of magnesium, sodium, and chloride of sodium (4⅓ per cent.). *Heat* will remove the organic matter and leave the inorganic; dilute *Nitric* or *Hydrochloric acid* will remove the inorganic, and leave the organic. In old age the inorganic constituents predominate, and the bones are brittle; in youth the organic predominate, and epiphyseal dislocation is more common than fracture, especially in the long bones of the extremities.

Describe the Structure of Bone. Bone is composed of an outer compact layer, and an inner cellular or spongy structure. It is surrounded, except at the articular cartilages, by a vascular fibrous membrane, *the Periosteum*, which receives the insertions of all tendons, ligaments, etc.; and the central cavity of long bones is lined by a similar structure, the *Endosteum*. A transverse section of bone, examined microscopically, shows—

Haversian Canals, diameter $\frac{1}{500}$ inch, for the passage of vessels.

Canaliculi, diameter $\frac{1}{16000}$ inch, radiating from the canals, and connecting them with the lacunæ.

Lacunæ, arranged circularly around the canals, and contain the bone-cells, appearing as irregular dark spaces.

Haversian Spaces, connect the canals with the medullary spaces, and divide one Haversian system from another. *An Haversian System* comprises an Haversian canal with its lamellæ, lacunæ, and canaliculi.

Concentric Lamellæ of bone tissue, around the canals.

Circumferential Lamellæ, are bone layers binding the canals together.

Interstitial Lamellæ, woven in between the concentric lamellæ.

What is the Marrow of Bone? In young bones a tenacious, transparent fluid, free from fat. In adult bones of a yellow color, consisting of fat in varying proportion and extractive matters. It is found in the medullary canal, the cancellous texture, and the large Haversian spaces.

What Vessels are found in Bones? Arteries, veins, and some say lymphatics. *The Arteries* are,—the nutrient, entering at the nutrient foramen; the articular, nourishing the cancellous structure; and the periosteal, which supply the periosteum and the compact structure. *The Veins* emerge from the ends, the shaft, and from the nutrient foramen.

Describe the process of Ossification. The site of bone is first occupied by a mucoid substance, which becomes temporary cartilage (*blastema*) in the second month of fœtal life. The young bone-cells (*osteo-blasts*) are then deposited in the cartilage at certain points, and their deposition and subsequent pressure cause the absorption of the cartilage. In most of the bones of the head and face, ossification is intra-membranous instead of intra-cartilaginous. *The first bones* in which ossification appears are the clavicle and inferior maxillary (5th to 7th fœtal week); the *last* is the pisiform bone (12th year). *Epiphyses* ossify after birth and begin uniting to the bone from the age of puberty, and in the inverse order to that in which their ossification began, except the lower end of the fibula, which ossifies and is joined to the shaft earlier than its upper end.

THE BONES OF THE HEAD.

THE FRONTAL BONE.

Describe the points on its vertical portion. They are as follows:—

Externally,—

Frontal Eminences, one on each side of the median line.

Depression, marking the site of the frontal suture before obliteration.

Superciliary Ridges, behind which are the frontal sinuses.

Supraorbital Notches or Foramina, in the supraorbital arches, at about their inner third, for the supraorbital vessels and nerves.

Nasal Eminence, at lower end of the frontal depression.

External Angular Processes, articulate with the malar bones and form the anterior part of the temporal ridges.

Internal Angular Processes, articulate with the lachrymal bones.

Nasal Spine and Notch, between the internal angular processes.

Internally,—

Groove, for superior longitudinal sinus and the falx cerebri.

Frontal Crest, for attachment of the falx cerebri.

Foramen Cæcum, for a small vein to the longitudinal sinus.

Depressions and Elevations, for convolutions of the brain.

Between the two tables of the vertical portion in the adult are the—

Frontal Sinuses, two spaces at the anterior inferior part of the bone, which are lined with mucous membrane, and open into the middle meatus of the nose by means of an *Infundibulum* for each.

Describe its horizontal portion, or orbital plates. They each present the following points, viz.—

Fossa, for the lachrymal gland, near the external angular process.

Depression, at the nasal margin for the pulley of the superior oblique muscle.

Ethmoidal Notch, having the following foramina on its margin.

Anterior Ethmoidal Foramen, for anterior ethmoidal vessels and the nasal branch of the ophthalmic nerve.

Posterior Ethmoidal Foramen, for posterior ethmoidal vessels.

Grooves, on the cranial surface, for branches of the anterior and middle meningeal arteries.

Describe its articulations, development, and muscles. The frontal *articulates* with 12 bones,—the sphenoid, ethmoid, 2 parietal, 2 nasal, 2 superior maxillary, 2 lachrymal, and 2 malar. It is *developed* by 2 centres in membrane, 1 for each lateral half. The *muscles* attached to it are 3 pairs,—the temporal, corrugator supercilii, and orbicularis palpebrarum.

THE PARIETAL BONES.

Describe their general characteristics. They are 2 quadrilaterally-shaped bones situated at the superior and lateral regions of the cranium. The superior border of each joins the other by the *Sagittal Suture;* the anterior border joins the frontal bone by part of the *Coronal Suture;* the posterior border articulates with the occipital, forming the *Lambdoidal Suture;* the inferior border with the sphenoid and temporal bones. Forming the lateral walls of the skull they are named parietal, from *paries*, a wall.

Describe the points on each Parietal bone. Externally the bone is convex and presents for examination,—

Temporal Ridge, continuous with the same on the frontal bone.

Parietal Eminence, the point where ossification commenced.

Parietal Foramen, close to the upper border, transmits a vein to the superior longitudinal sinus. Is not constant.

Internally, the bone is concave, and marked by—

Depressions for the Pacchionian bodies, and for the cerebral convolutions.

Furrows, for branches of the middle meningeal artery.

Groove, for the lateral sinus, at the posterior inferior angle.

Half-groove, along the upper border, for the superior longitudinal sinus of the dura mater.

Describe their articulations, development, and muscles. Each parietal bone *articulates* with 5 bones,—the frontal, occipital, sphenoid, temporal, and opposite parietal. It is *developed* from 1 centre in membrane. The *only muscle* attached to it is the temporal.

THE OCCIPITAL BONE.

Describe its general features and surfaces. It is trapezoidal in form, curved upon itself, and placed at the posterior and inferior region of the cranium. Externally its surface is convex and presents for examination the following, viz.—

External Occipital Protuberance, and Crest, for the attachment of the ligamentum nuchæ.

Superior and Inferior Curved Lines, extending outwards on each side of the external occipital crest.

Foramen Magnum, transmitting the medulla oblongata and its membranes, the vertebral arteries, and the spinal accessory nerves.

Condyles, 2 in number, for articulation with the atlas vertebra.

Tubercles, 1 on each condyle, for the check ligaments.

Anterior Condyloid Foramina, 2, for the hypoglossal nerves.

Posterior Condyloid Foramina, 2, (often absent) for veins.

Jugular Processes, 2, each helping to form the foramen lacerum posterius basis cranii.

Internally, the surface is concave, showing—

Fossæ, 4, for the cerebellar and posterior cerebral lobes.

Internal Occipital Protuberance, where 6 cranial sinuses meet to form the torcular (wine-press) Herophili.

Crucial Ridge, the vertical portion for the falx cerebri and falx cerebelli; the transverse portion for the tentorium cerebelli, having also a groove for the lateral sinus.

Groove, for the lateral sinus, and the inferior petrosal sinus, along the postero-lateral border.

Internal Openings of the foramina described above.

Describe the Basilar Process of the Occipital. It lies in front of the foramen magnum, articulates with the body of the sphenoid bone, smooth and grooved internally for the medulla oblongata and pons varolii, which lie upon it; rough inferiorly for the attachment of muscles, and presenting the—

Pharyngeal Spine, for the attachment of the superior constrictor muscle of the pharynx and its tendinous raphé.

Describe its articulations and development. The occipital *articulates* with 6 bones,—the 2 parietal, 2 temporal, sphenoid, and atlas. It is *developed* by 4 centres, 1 each for the posterior part, the basilar process, and the 2 condyles; its ossification being completed about the 6th year of age.

What muscles are attached to the Occipital Bone? There are 12 muscles attached on each side to the following portions, viz.—

Superior Curved Line 3—the occipito-frontalis, trapezius, and sterno-cleido-mastoid.

Space between the curved lines 2—the complexus and splenius.

Space below the inferior curved line 3—the obliquus capitis superior, rectus capitis posticus major and minor.

Basilar Process 3—the superior constrictor of the pharynx, rectus capitis anticus major and minor.

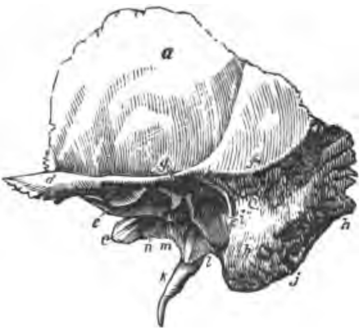
Jugular Process 1—the rectus capitis lateralis.

THE TEMPORAL BONES.

Describe their situation and divisions. They are situated at the inferior lateral portions of the skull, and contain the organs of hearing. Each bone is divided into 3 parts, the *Squamous*[a] (scale-like), *Mastoid*[b] (nipple-like), and *Petrous*[c] (hard); and it is named from being the site of the first gray hairs (*tempus*, time).

Describe the Squamous Portion. It is a semicircular plate, smooth externally, and grooved internally for the middle meningeal artery, with depressions for the cerebral convolutions. Externally are seen the—

FIG. 1.



Zygomatic Process,[d] or zygoma, arising by 3 roots, and extending forwards to articulate with the malar bone.

Zygomatic Tubercle,[e] at the base of the process, for the external lateral ligament of the lower jaw.

Eminentia Articularis, formed by the anterior root of the zygoma.

Glenoid Fossa,[g] between the anterior and middle roots of the zygoma; its anterior part receives the condyle of the lower jaw, and is covered with cartilage; its posterior part lodges the parotid gland.

Glasserian Fissure, divides the glenoid fossa; it transmits the laxator tympani muscle, the tympanic artery, and the processus gracilis of the malleus.

Opening of the Canal of Hugier, lies in the angle between the squamous and petrous portions of the bone; and transmits the chorda tympani nerve.

Temporal Ridge,f in part.

Describe the Mastoid Portion. It projects like a nipple from the inferior portion of the bone posteriorly. Internally it is grooved for the lateral sinus;[9] externally are seen the—

Mastoid Foramen,[h] the largest of several foramina, for a vein.

Mastoid Process, at the tip, for the sterno-cleido-mastoid, splenius, and trachelo-mastoid muscles.

Digastric Fossa,j for the posterior belly of the digastric muscle.

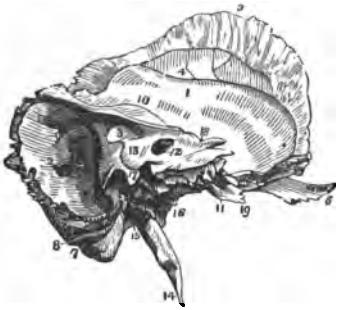
Occipital Groove,[8] for the occipital artery.

Mastoid Cells, in the interior of the mastoid process, open on the posterior wall of the middle ear, and are lined with mucous membrane.

Describe the Petrous Portion. It is very hard, pyramidal in form, contains the internal and middle ear, projects inwards and forwards, and presents a base, an apex, three surfaces, and three borders.

On the Base are seen, the—

FIG. 2.



Meatus Auditorius Externus,i the external opening of the ear.

Auditory Process, a bony ring for the external cartilage of the ear.

Apex lies internally, at the base of the skull, forming the outer boundary of the foramen lacerum medium, and contains the internal carotid canal.

Anterior Surface, presents from within, outwards—

Opening of the Carotid Canal,[11] for the internal carotid artery and plexus.

Depression, for the Gasserian ganglion of the 5th pair of cranial nerves.

Hiatus Fallopii, for great petrosal nerve and an artery.

Foramen, for small petrosal nerve.

Eminence, over the superior semicircular canal of the ear.

Depression, over the tympanum.

Posterior Surface, presents—

Meatus Auditorius Internus,[12] transmits the 7th and 8th pairs of cranial nerves and the auditory artery, and lodges a process of dura mater.

Opening of the Aqueductus Vestibuli,[13] transmits to the vestibule a small artery and vein, and lodges a process of dura mater.

Inferior surface, presents from within outwards—

Rough Quadrilateral Surface,[19] for the origin of the tensor tympani and levator palati muscles.

Opening of the Carotid Canal, transmitting the internal carotid artery, and the carotid plexus of the sympathetic nerve.

Aqueductus Cochleæ, transmitting a vein from the cochlea.

Jugular Fossa, a depression for the sinus of the internal jugular vein, forming with the occipital bone the foramen lacerum posterius, which transmits that vein and the 8th pair of cranial nerves, etc. (*See* page 35.)

Foramen for Jacobson's Nerve (tympanic branch of the glosso-pharyngeal), in the ridge between the jugular fossa and the carotid canal.

Foramen for Arnold's Nerve (auricular branch of the pneumogastric), in the outer wall of the jugular fossa.

Jugular Surface, for articulation with the jugular process of the occipital bone.

Vaginal Process,[l] ensheathing the root of the styloid process.

Styloid Process,[14] a long projection for the stylo-pharyngeus, stylo-hyoid, and stylo-glossus muscles (3); and the stylo-hyoid and stylo-maxillary ligaments (2), which are attached thereto.

Stylo-mastoid Foramen,[15] between the styloid and mastoid processes, for the exit of the facial nerve, and the entrance of the stylo-mastoid artery.

Auricular Fissure, for the exit of Arnold's nerve.

In the angle between the petrous and squamous portions, are seen the—

Septum Tubæ, a lamina separating the following canals. Its inner end projects into the tympanum, and is called the *Processus cochleariformis.*

Opening of the canal for the tensor tympani muscle.

Osseous Opening of the Eustachian tube[n] inferiorly.

The Anterior Border articulates partly with the spinous process of the sphenoid bone.

The Posterior Border assists in forming the jugular foramen, and is grooved for the inferior petrosal sinus.

The Superior Border separates the anterior fossa of the skull from the middle fossa; to it is attached the tentorium cerebelli, and it is grooved for the superior petrosal sinus.[10]

Describe its articulations and development. The temporal *articulates* with 5 bones,—the occipital, parietal, sphenoid, malar, and inferior maxillary. It is *developed* by 4 centres, one each for the squamous portion, styloid process, and auditory process, and one for the petrous and mastoid portions. Its ossification is completed about the 2d or 3d year.

What muscles are attached to it? There are 14 muscles attached to the following-named portions. To the—

Squamous Portion 2,—the temporal and masseter.

Mastoid Portion 6,—the occipito-frontalis, sterno-cleido-mastoid, splenius capitis, trachelo-mastoid, digastric, and retrahens aurem.
Petrous Portion 3,—the tensor tympani, levator palati, and stapedius.
Styloid Process 3,—the stylo-glossus, stylo-hyoid, and stylo-pharyngeus.

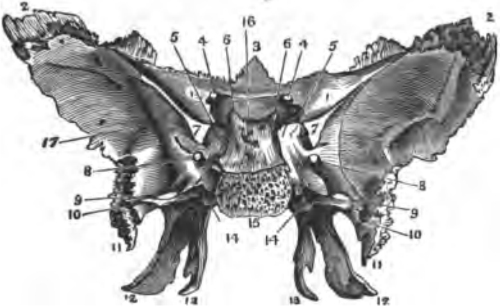
THE SPHENOID BONE.

Describe its Position and Form. Wedged in between the bones of the skull anteriorly, it resembles a bat with out-stretched wings. It is named from the Greek word σφὴν *sphane*, a wedge, enters into the formation of 5 cavities, 4 fossæ, 3 fissures, and has—

A Body.
2 Greater Wings.[2]
2 Lesser Wings.[1]
10 Points of Ossification.
2 Pterygoid Processes.
2 Styloid Processes.
6 Clinoid Processes.
3 Lesser Processes.
12 Foramina.
12 pairs of Muscles.
12 Articulations.

Describe the Body of the Sphenoid Bone. Placed in the median line, cuboid in shape, it presents on its Upper Surface from before backwards, the following points, viz.—

FIG. 3.



Ethmoidal Spine,[3] articulating with the ethmoid bone.
A Smooth Surface, grooved for the olfactory nerves.
Optic Groove, supporting the commissure of the optic nerves.
Olivary Process, an olive-shaped eminence behind the optic groove.
Middle Clinoid Processes, bounding the sella Turcica in front.
Sella Turcica[16] (Turkish saddle), lodges the pituitary body and the circular sinus of the brain.
Dorsum Sellæ (back of the saddle), grooved for the 6th nerves.
Posterior Clinoid Processes,[6] for attachment of the tentorium cerebelli.
Grooves, laterally, for the cavernous sinus and internal carotid artery.

The posterior surface is rough and quadrilateral:[15] it articulates with the basilar process of the occipital bone, ossification being completed from the 18th to the 20th year.

THE ANTERIOR SURFACE is nearly vertical, and presents the—

Lamella, in the median line, articulating with the perpendicular plate of the ethmoid bone, and forming part of the nasal septum.

Opening of the Sphenoidal Sinuses,[e] or cavities in the body of the bone which exist in adults, not in children.

Sphenoidal Turbinated Bones (pyramids of Wistar), which partially close the sinuses, and articulate with the ethmoid and palate bones.

THE INFERIOR SURFACE helps to form the nasal fossæ, and presents the—

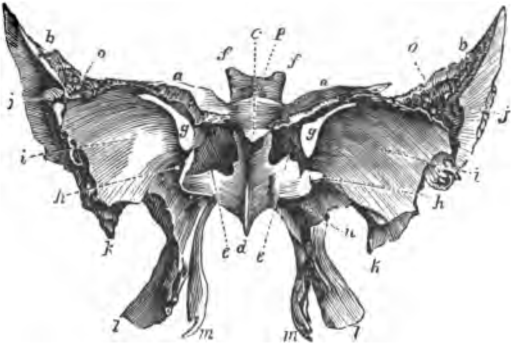
Rostrum,[d] which articulates with a groove on the vomer.

Vaginal Processes, 1 on each side of the rostrum.

Pterygo-palatine Grooves, which, with the sphenoidal processes of the palate bones, form the pterygo-palatine canals, for the transmission of the pterygo-palatine arteries and nerves.

Describe the Greater Wings of the Sphenoid. Each wing, on its SUPERIOR SURFACE, presents the following points, viz.—

FIG. 4.



Foramen Rotundum,[8] for the superior maxillary division of the 5th.

Foramen Ovale,[9] for the inferior maxillary division of the 5th nerve, the small petrosal nerve, and the small meningeal artery.

Foramen Vesalii, transmitting a small vein.

Foramen Spinosum,[10] transmitting the middle meningeal artery.

THE ANTERIOR SURFACE assists in forming the external wall of the orbit, the spheno-maxillary and sphenoidal fissures. It articulates with the frontal and malar bones, and presents a—

Notch, transmitting a branch of the ophthalmic artery.

Spine, for part of the lower head of the external rectus muscle.

External Orbital Foramina, transmitting arterial branches.

THE EXTERNAL SURFACE presents the following points,—

Pterygoid Ridge, dividing the temporal fossa from the zygomatic.

Spine of the Sphenoid,[11] to which are attached the internal lateral ligament of the lower jaw, and the laxator tympani muscle.

THE CIRCUMFERENCE is partly serrated for articulation with the temporal and frontal bones, and partly smooth for the anterior margin of the foramen lacerum medium and the inferior margin of the sphenoidal fissure, which margins it assists in forming.

Describe the Lesser Wings[1] of the Sphenoid. Called also the Processes of Ingrassias,[a] they terminate internally in the *Anterior Clinoid Processes*;[5] their anterior borders articulate with the orbital plate of the frontal bone, the posterior are free, dividing the anterior cerebral fossa from the middle. Connected intimately with each of these wings are the—

Optic Foramen,[4] formed by the separation of its roots, and transmitting the optic nerve and the ophthalmic artery.

Sphenoidal Fissure,[7] or foramen lacerum anterius,[g] is bounded above by the lesser wing, below by the greater wing, and transmits the 3d, 4th, ophthalmic division of the 5th, and the 6th nerves, the ophthalmic vein, branches of the lachrymal and middle meningeal arteries, some filaments of the sympathetic nerve, and a process of the dura mater.

Describe the Pterygoid Processes of the Sphenoid. The wing-like processes descend, 1 on each side of the body, and divide each into 2 thin, bony plates,[lm] connected together anteriorly, and presenting—

Pterygoid Fossa, between the plates posteriorly, the origin of the external pterygoid muscle.

Scaphoid Fossa, at the base of the internal plate, serves as the origin of the tensor palati muscle.

Hamular Process, a hook-like projection at the apex of the internal plate, around which plays the tendon of the tensor palati muscle.

Vidian Canal,[14] at the root of the process, for the Vidian nerve and vessels.

Triangular Notch, at the end of the process, articulates with the pterygoid process of the palate bone.

With what bones does the Sphenoid articulate? With 12, the other 7 bones of the cranium and 5 of the face,—the vomer, 2 malar, and 2 palate.

How is the Sphenoid developed? By 10 centres, as follows.—2 for the greater wings, 2 for the lesser wings and anterior part of the body, 2 for the posterior part of the body, 2 for the pterygoid processes, and 2 for the sphenoidal turbinated processes. Ossification begins in the 2d fœtal month, and is completed about the 11th year, by the union of the turbinated processes with the body.

What muscles are attached to the Sphenoid bone? There are 12 pairs, as follows, viz.—

Orbital muscles, 6—all except the inferior oblique of the eye.

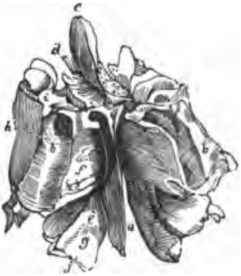
Muscles of Mastication, 3—the temporal, external and internal pterygoids. Superior constrictor, tensor palati, and laxator tympani, 3.

THE ETHMOID BONE.

Describe its General Characteristics. It is a spongy, light bone, depending from the ethmoidal notch of the frontal, and from between its orbital plates. It consists of a body and 2 lateral masses, and is named from the Greek word ἠθμος, *aythmos*, a sieve.

What are the Points on its Body? The body[b] consists of a horizontal or cribriform plate, and a perpendicular plate, and presents the—

FIG. 5.



Crista Galli,[c] or cock's comb, projecting upwards, for the attachment of the anterior end of the falx cerebri.

Cribriform Plate,[d] on each side of the crista galli. It is concave for the olfactory bulbs,[i] and perforated for the transmission of the olfactory nerves, the nasal branch of the ophthalmic nerve, and numerous small vessels.

Perpendicular Plate,[a] assists to form the nasal septum, is usually inclined to one side, grooved for filaments of the olfactory nerves, and has attached to it the cartilage of the nose.

Describe the Lateral Masses. They consist of a number of cellular cavities, and each one presents the following points, viz.—

Ethmoid Cells, the anterior opening by the infundibulum into the middle meatus of the nose, the posterior into the superior meatus.

Os Planum,[h] or orbital plate, helps to form the inner wall of the orbit, and is notched superiorly to form with the frontal bone the two ethmoidal foramina.

Unciform Process, descends to articulate with the inferior turbinated, and forms part of the inner wall of the antrum.

Superior Turbinated Process,[f] curves downwards and outwards.

Middle Turbinated Process,[g] is larger and more curved than the superior. These processes bound the superior meatus of the nose, and are often called the superior and middle turbinated bones.

Describe its articulations, development, and muscles. The ethmoid *articulates* with 15 bones, viz.—all those of the face except the malar, and the frontal and sphenoid of the cranium. It is *developed* by 3 centres, 1 for each lateral mass, and 1 for the body, ossification being completed about the 6th year. There are no *muscles* attached to it.

THE NASAL BONES.

Describe them. They are 2 small bones forming the bridge of the nose by articulation with each other in the median line. They are convex externally, concave internally, and grooved for the external branch of the nasal nerve and for small arteries. They each *articulate* with 4 bones,—the frontal, ethmoid, superior maxillary, and the opposite nasal; are each *developed* by one centre of ossification, and have *no muscles* attached to them.

THE SUPERIOR MAXILLARY BONES.

Describe them. They are 2 hollow bones, together forming the upper jaw. Each bone consists of 4 processes, and a body which possesses a large cavity, the antrum of Highmore.

Describe the Antrum of Highmore. It is a pyramidal cavity in the body of the bone, and opens into the middle meatus of the nose by an aperture which is very small in the recent subject, admitting only a small probe. Its walls are very thin, and are covered internally by a mucous membrane. It presents the—

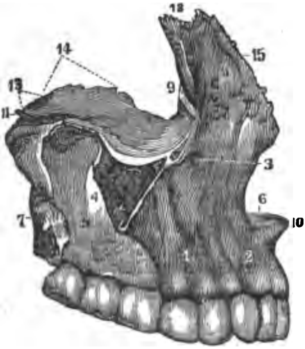
Aperture, partly closed by the articulation of the unciform process of the ethmoid with the ethmoidal process of the inferior turbinated; and that of the maxillary process of the palate with a fissure in the superior maxillary; also by the maxillary process of the inferior turbinated which hooks over the lower edge of the orifice.

Posterior Dental Canals, on the posterior wall of the cavity.

Processes in its floor, formed by the alveoli of the 1st and 2d molar teeth, the roots of which occasionally perforate it.

What other points are presented by the body? The body has 4 surfaces, the facial externally, the zygomatic posteriorly, the orbital superiorly, and an internal surface forming part of the outer wall of the nose and the cavity of the mouth. It presents the—

Fig. 6.



Incisive Fossa,[2] on the facial surface, above the incisor sockets, for the origin of the depressor alæ nasi muscle.

Canine Fossa,[1] more externally, for the levator anguli oris.

Infraorbital Foramen,[3] above the canine fossa, transmitting the infraorbital vessels and nerve, from the *infraorbital canal* in the orbital surface of the bone.

Maxillary Tuberosity, articulates with the tuberosity of the palate bone.

Turbinated Crests, inferior and superior, on the inner surface, bounding horizontal grooves which correspond to the meati of the nose.

Vertical Grooves, on the inner surface, one assisting to form the nasal duct, the other to form the posterior palatine canal.

Rough Surface, for articulation with the palate bone.

Orbital Surface, articulating with the lachrymal, ethmoid, and palate bones interiorly, partly bounding the spheno-maxillary fissure exteriorly, and forming the lower margin of the orbit anteriorly.

Infraorbital Groove, along the orbital surface, ending in the infraorbital canal and foramen. (See *ante*.)

Depression, for the origin of the inferior oblique muscle of the eye.

Describe its Processes. They number 4, as follows.—

MALAR PROCESS,[4] is triangular, looks outwards from the body, and is rough for articulation with the malar bone.

NASAL PROCESS,[8] is thin anteriorly and serrated superiorly for articulation with the nasal bone; posteriorly it is smooth and articulates with the lachrymal. It presents the—

Turbinated Crests, superior and inferior, the former articulating with the middle turbinated process of the ethmoid bone.

Outer Surface, gives origin to the orbicularis palpebrarum and levator labii superioris alæque nasi muscles, and the tendo oculi.

Groove on the posterior border, helping to form the nasal duct.

ALVEOLAR PROCESS, forms the curved line of the teeth, and presents—

Alveoli, or sockets, for 8 teeth in the adult, 5 in the child.

PALATE PROCESS, forms part of the floor of the nasal cavity, and the roof of the mouth. It articulates with the vomer, the palate bone, and with its fellow process, and presents the—

Incisive Foramen, or foramen of Stenson, leading into the anterior palatine canal, for the anterior palatine vessels.

Foramina of Scarpa, 2, transmitting the naso-palatine nerves.

Groove on the under surface, for the protection of the vessels and nerves.

Orifice of the posterior palatine canal, at the posterior end.

Nasal Crest, at the articulation of the two processes with the vomer.

Anterior Nasal Spine, the anterior extremity of the nasal crest.

Describe its articulations and development. The superior maxillary *articulates* with 9 bones,—the frontal,[12] ethmoid,[14] vomer,[18] nasal,[16] lachrymal, malar, palate, inferior turbinated, and opposite superior maxillary.[10] It is *developed* probably by 4 centres,—1 for the facial and nasal parts, another for the orbital and malar, a 3d for the incisive, and a 4th for the palate portion.

What muscles are attached to it? There are 11, viz.—the orbicularis palpebrarum, and levator anguli oris alæque nasi, 2, to the *nasal process;*—the levator labii superioris, levator anguli oris, compressor naris, depressor alæ nasi, orbicularis oris, and inferior oblique of the eye, 6, *to the body;*—the buccinator, 1, to the *alveolar process;*—the masseter, 1, to the *malar process;*—and the external pterygoid, 1, to the *tuberosity.*

THE LACHRYMAL BONES.

Describe them. They are 2 small quadrilateral-shaped bones, situated in the anterior part of the inner wall of the orbit. Each presents a—

Groove, on the external surface, forming part of the nasal duct.

Ridge, also externally, for attachment of the tensor tarsi muscle.

Furrow, internally, corresponding to the ridge on the external surface.

Hamular Process, projecting downwards to articulate with the lachrymal process of the inferior turbinated bone.

Internal Surface, closes the anterior ethmoidal cells.

Describe its articulations, development, and muscles. The lachrymal *articulates* with 4 bones,—the frontal, ethmoid, superior maxillary, and inferior turbinated. It is *developed* from 1 centre, and has but 1 *muscle* attached to it, the tensor tarsi, or Horner's muscle.

THE MALAR BONES.

Describe them. The cheek bones are situated at the outer and upper part of the face, aiding to form the cavities of the orbits and the temporal and zygomatic fossæ. Each presents an—

External Surface, convex, for attachment of the zygomatic muscles.

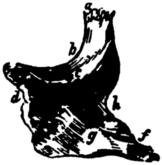
Foramen, externally, for the malar branch of the temporo-malar nerve.

Foramen,[c] internally, for the temporal branch of the same nerve.

Frontal Process,[a] articulates with the external angular process of the frontal.

Orbital Process,[b] projecting backwards, forming part of the floor and outer wall of the orbit, as well as part of the temporal fossa, and bounds the spheno-maxillary fissure anteriorly.

FIG. 7.



Zygomatic Process,[f] projecting backwards to articulate with the zygomatic process of the temporal bone by a serrated edge.

Upper Border,[b] forms the outer and inferior margin of the orbit.

Lower Border, thick and rough, for the origin of the masseter muscle.

Anterior Border,[d] articulates with the superior maxillary bone.

Posterior Border, terminates the temporal fossa below.

Name its articulations, centres, and muscles. The malar *articulates* with 4 bones,—the frontal, sphenoid, temporal, and superior maxillary. It is *developed* by one centre of ossification, and has 5 *muscles* attached to it,—the levator labii superioris, zygomaticus major and minor, masseter and temporal.

THE PALATE BONES.

Describe them. They are 2 irregularly-shaped bones, situated posteriorly in the nares. Each bone assists in forming the floor and outer wall of the nose, the roof of the mouth, the floor of the orbit, the inner wall of the antrum, the zygomatic, spheno-maxillary, and pterygoid fossæ, and presents the following points.—

HORIZONTAL PLATE,[a] completes the nasal floor and hard palate; has a—

Ridge, on the inferior surface, for the tensor palati aponeurosis.

Groove, assisting to form the posterior palatine canal.

Foramina, transmitting the anterior and posterior palatine nerves.

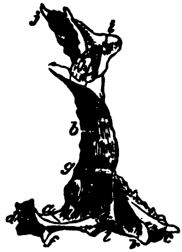
Anterior Border, is serrated, and joins the superior maxillary bones.

Posterior Border, is free and concave, for the attachment of the soft palate.

Inner Border,[d] is thick, and articulates with its fellow, forming a groove for the reception of the vomer. Its posterior extremity is the—

Posterior Nasal Spine, for the origin of the azygos uvulæ muscle.

FIG. 8.



VERTICAL PLATE,[b] a broad and thick lamella, presents the following:—

Superior Turbinated Crest, on the inner surface. Below it is the—

Inferior Turbinated Crest,[g] dividing the middle meatus of the nose from the inferior, and articulating with the inferior turbinated bone.

Posterior Border, articulates with the pterygoid process of the sphenoid.

Groove, on the external surface, helping to form the posterior palatine canal.

Two Smooth Surfaces, externally, one forming the inner wall of the zygomatic fossa; the other, part of the inner wall of the antrum.

Two Rough Surfaces, also externally, one for articulation with the superior maxillary; the other with the pterygoid process of the sphenoid.

Deep Notch, which by articulation with the sphenoid bone, forms the *spheno-palatine foramen*,[h] for the spheno-palatine nerves.

PTERYGOID PROCESS,[c] is wedged into the notch between the plates of the pterygoid process of the sphenoid, with which it articulates laterally. In it are the—

Palatine Foramina, for the external and posterior palatine nerves.

Posterior Surface, aids in forming the pterygoid fossa.

ORBITAL PROCESS,[i] triangular in shape, large and hollow. It has—

Three Articular Surfaces, for the sup. maxillary, sphenoid, and ethmoid.

Two Free Surfaces, the orbital forming part of the floor of the orbit, the external aiding to form the zygomatic fossa.

Rounded Border, forms a part of the spheno-maxillary fissure.

SPHENOIDAL PROCESS,[j] projects backwards, articulates superiorly with the body of the sphenoid, and externally with the pterygoid process of the sphenoid. On its upper surface is a—

Groove, which assists in forming the pterygo-palatine canal.

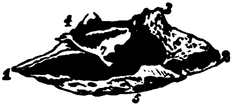
Inner Surface, forms part of the outer wall of the nasal fossa.

Describe its articulations, development, and muscles. The palate *articulates* with 6 bones,—the sphenoid, ethmoid, vomer, superior maxillary, inferior turbinated, and its fellow palate bone. It is *developed* by one centre at the junction of the two plates. There are 5 *muscles* attached to it,—the azygos uvulæ, internal and external pterygoids, superior constrictor, and tensor palati.

THE INFERIOR TURBINATED BONES.

Describe them. They are 2 thin curved osseous plates situated in the nasal fossæ, their convex surfaces presenting inwardly. Each bone is attached above to the inferior turbinated crests of the superior maxillary and palate bones, and presents the following, viz.—

FIG. 9.



Lachrymal Process,[3] aiding to form the nasal duct, by articulation with the lachrymal and superior maxillary bones.

Ethmoidal Process,[1] articulating with the unciform process of the ethmoid, thus helping to partially close the aperture of the antrum.

Maxillary Process,[4] also helps to partially close the aperture of the antrum, by hooking[7] over the lower edge of that orifice.

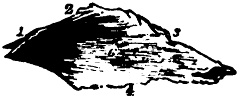
Free Border,[5] below, coming to about ½ inch above the floor of the nose.

Name its articulations, centres, and muscles. The inferior turbinated *articulates* with 4 bones, the ethmoid, lachrymal, palate, and superior maxillary. It is *developed* by one centre, and has *no muscles* attached to it.

THE VOMER.

Describe it. The vomer (plough-share) forms the postero-inferior part of the nasal septum, but is usually bent to one side. Its—

FIG. 10.



Superior Border,[1] [2] has a groove and two alæ or wings, for articulation with the rostrum and vaginal processes of the sphenoid bone.

Anterior Border,[3] is grooved for the ethmoidal plate and the nasal cartilage.
Inferior Border,[4] the longest, articulates with the nasal crest of the superior maxillary and palate bones.
Posterior Border, is free and presents towards the pharynx.
Naso-palatine Grooves, laterally, for the naso-palatine nerves.
Furrows, on the lateral surfaces,[6] for vessels and nerve-filaments.

Name its articulations, centres, and muscles. The vomer *articulates* with 6 bones,—the sphenoid, ethmoid, 2 superior maxillary, and 2 palate bones. It is *developed* by one centre, which appears about the 6th fœtal week in cartilage between two laminæ which coalesce after puberty. It has *no muscles* attached to it.

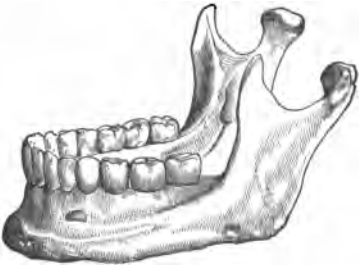
THE INFERIOR MAXILLARY BONE.

Describe its general characteristics. The inferior maxillary bone forms the lower jaw, receives the inferior teeth, and is the second bone of the body in which ossification appears, the clavicle being the first. It consists of a body and two rami.

Describe the Body of the bone. It is shaped somewhat like a horseshoe, and presents for examination the following: viz.—
Alveolar Portion, above the oblique line, containing on its upper border *alveoli* for 16 teeth in the adult, for 10 in the child.
Symphysis, a vertical ridge on the median line, marking the junction of the two symmetrical portions of which the bone originally consisted.
Mental Process, a prominent triangular eminence, forming the chin.

Externally on each side from the symphysis backwards, are the—
Incisive Fossa, above the chin, for the origin of the levator menti.
Mental Foramen, below the 2d bicuspid alveolus, transmitting the mental artery and nerve.
External Oblique Line, for the origins of the depressor labii inferioris and depressor anguli oris muscles from its anterior half.
Groove, near the angle, for the facial artery.

FIG. 11.



Internally, on each side from the median depression backwards, are the—
Genial Tubercles, the superior for the genio-hyo-glossus muscle; the inferior for the genio-hyoid.
Mylo-hyoid Ridge, obliquely backwards, for the mylo-hyoid muscle.

Sublingual Fossa, near the genial tubercles, for the sublingual gland.

Fossa, below the sublingual, for the anterior belly of the digastric muscle.

Submaxillary Fossa, below the ridge, for the submaxillary gland.

Describe the Rami of the Inferior Maxillary. The rami, or ascending portions of the bone, are 2 in number, and each present the—

Coronoid Process, anteriorly, for the insertion of the temporal muscle.

Condyloid Process, posteriorly. Its condyle articulates with the glenoid fossa of the temporal bone, its *neck* receives the insertion of the external pterygoid muscle, its *tubercle* has attached to it the external lateral ligament of the lower jaw.

Sigmoid Notch, a deep depression separating the above-named processes from each other, and crossed by the masseteric vessels and nerve.

Groove, on the coronoid process internally, and prolonged downwards upon the body, for the attachment of the buccinator muscle.

Ridges, on the external surface, for the insertion of the masseter.

Spine, a projection on the internal surface, for the attachment of the internal lateral ligament of the jaw.

Inferior Dental Canal, opening behind the spine, lies within the ramus and body of the bone for the inferior dental vessels and nerve. It communicates with each alveolus and with the mental foramen.

Mylo-hyoid Groove, below the spine, for the mylo-hyoid vessels and nerve.

Rough Surface, behind the groove, for the internal pterygoid muscle.

Angle of the Jaw, at the junction of the posterior body of the ramus with the inferior border of the body, for the insertion of the masseter and internal pterygoid muscles, and the stylo-maxillary ligament.

Describe the Articulations and Development of the Inferior Maxillary bone. It *articulates* with one pair of bones,—the temporal. It is the earliest formed bone in the body except the clavicle, and is probably *developed* by 2 centres, one for each lateral half, the two halves coalescing at the symphysis about the 1st year of age. In *adult life* the ramus arises almost vertically from the body, and the dental canal lies about the middle of the body. In *old age* the ramus extends obliquely backwards, the angle becoming very obtuse; and the alveolar portion being absorbed, the dental canal is near the superior border.

What Muscles are attached to the Inferior Maxillary? They number 15 pairs,—the masseter, internal and external pterygoids and temporal, 4, to *the ramus;*—the genio-hyo-glossus, genio-hyoid, myio-nyoid, digastric, and superior constrictor, 5, to the internal surface of *the body;*—the depressor labii inferioris, depressor anguli oris, levator menti, orbicularis oris, platysma myoides, and buccinator, 6, to the external surface of *the body.*

THE ORBITS.

Describe the Orbital Cavities. The orbits are 2 conoidal cavities, situated between the forehead and the face, their bases outwards, their apices pointing backwards, the lines of axial prolongation meeting at the sella turcica of the sphenoid bone. They contain the organs of vision with their appendages, and are each formed by 7 bones,—the frontal,[1] ethmoid,[2] sphenoid,[3] [4] [5] lachrymal,[6] superior maxillary,[7] palate,[8] and malar,[9] of which the first three are common to both orbits. Each orbit communicates with 1 cavity and 4 fossæ, as follows, viz.—

Cavity of the cranium, by the optic foramen [11] and sphenoidal fissure.[10]

Fossæ (4)—the nasal, temporal, zygomatic, and spheno-maxillary,—by the nasal duct [12] and the spheno-maxillary fissure.[13]

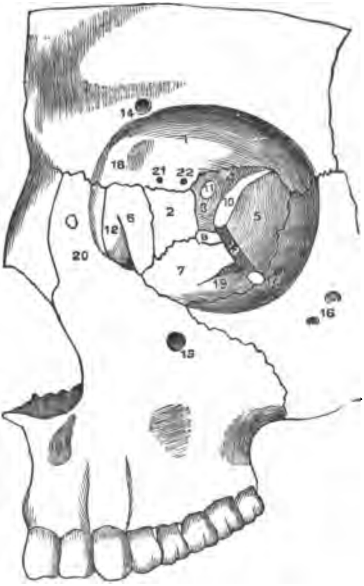
What Foramina communicate with each orbit? Nine,—the optic foramen,[11] sphenoidal fissure,[10] anterior [21] and posterior [22] ethmoidal foramina, supraorbital,[14] infraorbital,[15] and malar foramina,[16] the nasal duct,[12] and the spheno-maxillary fissure.[13]

Describe the Roof of the Orbit. Formed by the orbital plate of the frontal bone anteriorly,[1] and the lesser wing of the sphenoid [4] posteriorly, it is concave, and presents the—

Lachrymal Fossa,[17] at its outer angle, for the lachrymal gland.

Depression,[18] at the inner angle, for the pulley of the superior oblique.

FIG. 12.



Describe the Floor of the Orbit. Formed by the orbital surface of the superior maxillary bone,[7] and the orbital process of the malar [9] and palate bones,[8] it is nearly flat and presents the—

Palato-maxillary Suture posteriorly.

Infraorbital Canal, and a *Depression* for the superior oblique muscle of the eye, anteriorly.

Infraorbital Groove,[19] posteriorly.

Describe the Inner Wall of the Orbit. Formed by the nasal process of the superior maxillary bone,[20] the lachrymal,[6] the os planum of the ethmoid,[2] and the body of the sphenoid,[8] it presents—

A Groove, for the lachrymal sac, and the *Lachrymal Crest,* anteriorly.
2 Sutures,—the ethmo-lachrymal, and the ethmo-sphenoidal.

Describe the Outer Wall of the Orbit. Formed by the orbital process of the malar bone,[9] and the greater wing of the sphenoid,[5] it presents the *Orifices*[16] of the malar canals, and the *Spheno-malar Suture.*

Describe the Angles of the Orbit. They present the following points.

IN THE SUPERIOR EXTERNAL ANGLE.

Sphenoidal Fissure,[10] or foramen lacerum anterius, transmits the 3d, 4th, ophthalmic division of the 5th, and the 6th nerves, the ophthalmic vein, branches of the lachrymal and middle meningeal arteries, filaments of the sympathetic nerve, and a process of the dura mater.

Articulations,—the fronto-malar, and fronto-sphenoidal.

IN THE SUPERIOR INTERNAL ANGLE.

Suture,—the lachrymo-ethmo-frontal, in which are the following foramina.

Anterior Ethmoidal Foramen,[21] transmitting the anterior ethmoidal artery and the nasal nerve.

Posterior Ethmoidal Foramen,[22] transmitting the posterior ethmoidal artery and vein.

IN THE INFERIOR EXTERNAL ANGLE.

Spheno-maxillary Fissure[13] (described under the Zygomatic Fossa).

IN THE INFERIOR INTERNAL ANGLE.

A Suture, the ethmo-maxillo-palato-lachrymal.

What other points are connected with the Orbit? Two, the supraorbital notch, and the optic foramen, as follows, viz.—

Supraorbital Notch or Foramen,[14] at the junction of the inner and middle thirds of the upper circumference, transmitting the supraorbital artery, veins, and nerve. A line prolonged from this notch through the interval between the bicuspid teeth of either jaw, will cross both the infraorbital and mental foramina, and the canine fossa of the superior maxillary bone.

Optic Foramen,[11] at the apex, is formed by the 2 roots of the lesser wing of the sphenoid, and transmits the optic nerve and the ophthalmic artery. From around its margin arises a tendinous ring, the common origin of the 4 recti muscles of the eye.

What Muscles arise within the Orbit? The 4 recti and 2 oblique of the eye, the levator palpebræ, and the tensor tarsi (8 in all).

THE FOSSÆ.

Describe the Nasal Fossæ. Together they form the cavity of the nose, being separated from each other by the *Septum Nasi.*[11] They open in front by the anterior nares, behind by the posterior nares; and extend from the palate processes of the superior maxillary and palate bones,[17] upwards to the base of the cranium. They are formed by 14 bones,—the ethmoid, sphenoid, frontal, vomer, 2 nasal, 2 superior maxillary, 2 lachrymal, 2 palate, and 2 inferior turbinated.

Describe the Septum Nasi.[11] It forms the inner wall of each nasal fossa, and is formed chiefly by the perpendicular plate of the ethmoid bone, the vomer, and the triangular cartilage of the septum; to a less extent by 5 other bones,—the rostrum of the sphenoid, the nasal spine of the frontal, and the crests of the nasal, palate, and superior maxillary bones.

Describe the points presented by each Nasal Fossa. They are—

ON THE ROOF.

Openings, posteriorly, into the sphenoidal sinuses.

Olfactory Foramina, and the *Nasal Slit*, in the cribriform plate of the ethmoid bone.

ON THE FLOOR.

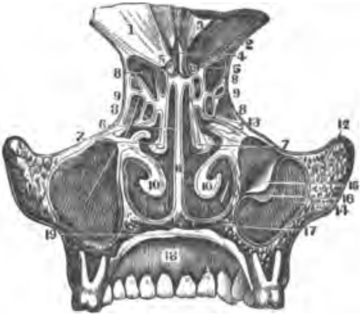
Orifice, of the anterior palatine canal.

Suture, between the bones forming the hard palate.

Nasal Spines, anterior and posterior, and the *Ridge* connecting them.

ON THE OUTER WALL, from above downwards.

FIG. 13.



Superior Turbinated process of the ethmoid.

Superior Meatus of the nose, into which open 3 orifices,—those of the posterior ethmoidal and the sphenoidal sinuses, and the spheno-palatine foramen.

Middle Turbinated[7] process of the ethmoid.

Middle Meatus of the nose, into which open 2 orifices,—those of the antrum[14] and infundibulum,—the latter draining the anterior ethmoidal cells,[8] and the frontal sinus.

Inferior Turbinated Bone,[10] below which is the—

Inferior Meatus of the nose, the largest; into it open 2 orifices,—those of the lachrymal, and anterior palatine canals. To these may be added the anterior and posterior nares.

Describe the Temporal Fossa. Situated on each side of the cranium, it is shallow above and behind, but deep in front and below; and is formed by parts of 5 bones,—the frontal, sphenoid, temporal, parietal, and malar. It is bounded above and behind by the temporal ridge, in front by the malar frontal and sphenoid bones, and below by the zygoma and the pterygoid ridge on the greater wing of the sphenoid. It is traversed by 6 sutures,—the spheno-malar, spheno-frontal, spheno-parietal, spheno-temporal, fronto-parietal, and temporo-parietal. It opens below into the zygomatic fossa; and lodges the temporal muscle, and the deep temporal vessels.

Describe the Zygomatic Fossa. Extending downwards from the temporal fossa, it is thus bounded,—

In front, by the tuberosity of the superior maxillary bone.

Externally, by the zygoma, and the ramus of the inf. maxillary.

Internally, by the external plate of the pterygoid process.

Above, by the temporal fossa, the squamous portion of the temporal bone, and the greater wing of the sphenoid.

Below, by the alveolar border of the inferior maxillary bone.

What Fissures open into the Zygomatic Fossa. Two, the—

Spheno-maxillary Fissure, between the greater wing of the sphenoid externally, and the superior maxillary and palate bones internally. It connects the orbit with the zygomatic, temporal, and spheno-maxillary fossæ; and transmits the infraorbital artery, the superior maxillary nerve and its orbital branches, and the ascending branches of Meckel's ganglion.

Pterygo-maxillary Fissure, between the tuberosity of the superior maxillary bone and the pterygoid process of the sphenoid. It transmits branches of the internal maxillary artery, and connects the zygomatic fossa with the spheno-maxillary.

Describe the Spheno-Maxillary Fossa. It is a triangular cavity between the pterygoid process of the sphenoid bone and the tuberosity of the superior maxillary, and is situated at the junction of the spheno-maxillary, pterygo-maxillary, and sphenoidal fissures. Into it open—

3 *Fossæ*,—the orbital, zygomatic, and nasal.

2 *Cavities*,—the cranial, and buccal.

5 *Foramina*,—the Vidian and pterygo-palatine canals, and the foramen rotundum, posteriorly; the spheno-palatine foramen on the inner wall; and the posterior palatine canal inferiorly;—occasionally also the accessory palatine canals.

THE SUTURES AND FONTANELLES.

Name the Sutures of the skull. There are 17.

At the Vertex of the skull are 5, the—

Sagittal, or interparietal.

2 Coronal, or fronto-parietal. 2 Lambdoid, or occipito-parietal.

At the Sides of the skull are 4, the—

2 Spheno-parietal. 2 Temporo-parietal.

At the Base of the skull are 5, the—

2 Temporo-occipital. Basilar, in the central line of the base.

2 Temporo-sphenoidal.

In the Mesial line, besides the sagittal and basilar, are 3, the—

Spheno-ethmoidal. Spheno-frontal. Ethmo-frontal.

Describe the Facial Sutures. The most important are the following, but the sutures of the face are very numerous.

Zygomatic Suture, at the temporo-malar articulation.

Transverse Suture, extending from one external angular process of the frontal bone across to the other, and connecting that bone with the malar, sphenoid, ethmoid, lachrymal, superior maxillary, and nasal bones.

Symphysis of the Chin, the site of a fœtal suture.

How are the Sutures formed? By dentations of the external tables interdigitating with each other, the adjacent edges of the internal tables lying in unjoined proximity. The sutures are not formed until a long time after the formation of the skull, probably to permit of the marginal growth of the bones.

What are the Fontanelles? They are 6 membranous intervals in the infant's skull, corresponding in situation with the angles of the two parietal bones. They are as follows, viz.—

Anterior, at the junction of the sagittal and coronal intervals.

Posterior, at the junction of the sagittal and lambdoid intervals.

Lateral Fontanelles, 4, two at the anterior inferior angles, and two at the posterior inferior angles of the parietal bones.

Describe the Wormian Bones. They are supernumerary small pieces of bone, irregularly shaped, and developed by special centres in unclosed portions of the cranial sutures and fontanelles, being more frequent in the lambdoid suture. They are also called "ossa triqueta" from their triangular form.

Describe the Hyoid Bone. It is shaped like a horse-shoe, has no articulation with the skeleton, but supports the tongue. It consists of a *Body*, two greater, and two lesser *Cornua* or horns. On the body is a *Crucial Ridge*, with a *Tubercle* at the centre. It is *developed* by 5 centres,—one for the body and one for each horn. Attached to it are 10 muscles, 3 ligaments, and 1 membrane, as follows, viz.—

To the Body,—the genio-, mylo-, stylo-, sterno-, thyro-, omo-hyoid, the genio-hyo-glossus, and the hyo-glossus muscles; also the pulley of the digastric, the hyo-epiglottic ligament, and the thyro-hyoid membrane.

To the Greater Cornu,—the hyo-glossus, middle constrictor muscles, and part of the thyro-hyoid;—also the thyro-hyoid ligament.

To the Lesser Cornu,—the stylo-hyoid ligament.

TABLE OF THE FORAMINA AT THE BASE OF THE SKULL,

with the various structures transmitted by each.

Anterior Fossa contains 1 single foramen and 5 in pairs, viz.—

Foramen Cæcum,—lodges a fold of dura mater, and transmits a vein to the longitudinal sinus from the nose, sometimes one from the frontal sinus.

Ethmoidal Fissure,—the nasal nerve, and the anterior ethmoidal artery.

Olfactory,—olfactory nerves, and nasal branches of the ethmoidal arteries.

Anterior Ethmoidal,—anterior ethmoidal artery and the nasal nerve.

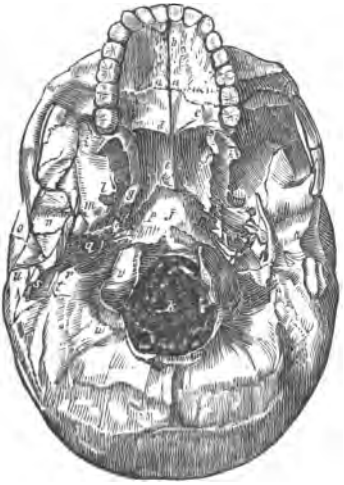
Posterior Ethmoidal,—posterior ethmoidal artery and vein.

Optic Foramen,—optic nerve and ophthalmic artery.

Middle Fossæ contain 8 pairs, viz.—

Foramen Lacerum Anterius, or *Sphenoidal Fissure,p*—the 3d, 4th, ophthalmic division of the 5th, and the 6th cranial nerves, and filaments of the sympathetic; ophthalmic vein, a branch of the lachrymal artery, orbital branches of the middle meningeal artery, and a process of dura mater.

FIG. 14.



Foramen Rotundum,—superior maxillary division of the 5th cranial nerve.

Foramen Vesalii,—a small vein. This foramen is often absent.

Foramen Ovale, l—inferior maxillary division of the 5th nerve, lesser petrosal nerve, and the small meningeal branch of the internal maxillary artery.

Foramen Spinosum, m—middle meningeal artery, meningeal veins, and sympathetic filaments from the cavernous plexus.

Foramen Lacerum Medium,[q]—internal carotid artery, carotid plexus, large petrosal nerve, and a branch from the ascending pharyngeal artery.

Small Foramen,—lesser petrosal nerve.

Hiatus Fallopii,—large petrosal nerve, branch of middle meningeal artery.

Posterior Fossa contains 6 pairs and 1 single, viz.—

Meatus Auditorius Internus,—facial and auditory nerves, auditory artery.

Aqueductus Vestibuli,—small artery and vein, process of dura mater.

Foramen Lacerum Posterius,[r]—glosso-pharyngeal, pneumo-gastric, and spinal accessory nerves, internal jugular vein, meningeal branches of the ascending pharyngeal and occipital arteries.

Mastoid Foramen (often absent),—small vein, occasionally the mastoid artery.

Anterior Condyloid Foramen,—hypoglossal nerve, meningeal branch from the ascending pharyngeal artery.

Posterior Condyloid Foramen[w] (often absent), posterior condyloid vein.

Foramen Magnum,[k]—medulla oblongata and its membranes, the vertebral arteries, and the spinal accessory nerves.

Externally, at the base of the skull are 10 pairs, viz.—

Opening of the Eustachian Tube,—air to the middle ear.

Opening of Tensor Tympani Canal,—the tensor tympani muscle.

Orifice of the Vidian Canal,—the Vidian nerve, and vessels.

Glasserian Fissure,[n]—laxator tympani muscle, tympanic artery, processus gracilis of the malleus.

Orifice of the Canal of Hugier,—chorda tympani nerve.

Foramen for Jacobson's Nerve,—tympanic branch of glosso-pharyngeal.

Foramen for Arnold's Nerve,—auricular branch of pneumogastric.

Opening of the Aqueductus Cochleæ,—vein to the cochlea.

Stylo-mastoid Foramen,[t]—facial nerve, stylo-mastoid artery.

Auricular Fissure,—exit of Arnold's nerve.

Face presents 3 pairs, viz.—

Supraorbital Foramen or Notch,—supraorbital artery, vein, and nerve.

Infraorbital Foramen,—infraorbital artery and nerve.

Mental Foramen;—mental artery and nerve.

Palate presents, on each side at least 6 pairs, viz.—

Incisive Foramina[b] (one or two),—nerves and vessels to the incisor teeth.

2 Anterior Palatine,—anterior palatine vessels, naso-palatine nerves.

Posterior Palatine,—posterior palatine vessels, anterior palatine nerve.

Accessory Palatine Foramina (one or two),—posterior palatine nerves.

Pterygo-palatine Foramen,—pterygo-palatine vessels.

THE BONES OF THE TRUNK.

THE VERTEBRAL COLUMN.

What Characteristics are Common to the Vertebræ? Each vertebra consists of a body and an arch, the latter being formed by 2 pedicles and 2 laminæ, which support 7 processes.

Body[6] is thick and spongy, convex in front[7] from side to side, concave vertically, and on the upper and lower surfaces, which are surrounded by a bony rim. Anteriorly are small foramina for nutrient vessels, posteriorly a large foramen for the exit of the venæ basis vertebrarum.

Pedicles, project backwards from the body, inclining outwards. They are notched above and below, thus forming, with the adjacent notches, the *Intervertebral Foramina* for the entrance of vessels and the exit of the spinal nerves.

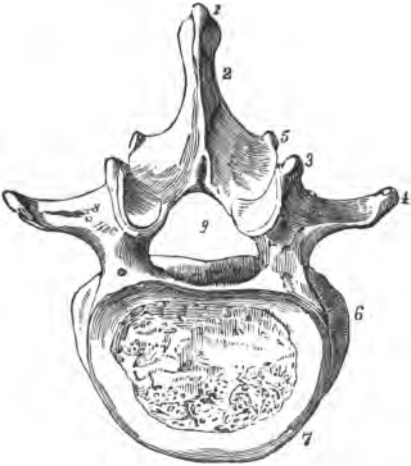
Laminæ,[2] are 2 broad plates, meeting in the spinous process behind, and rough on their upper and lower borders for the attachment of the ligamentum subflava.

Transverse Processes,[4] one on each side, projecting outwards.

Articular Processes, two on each side, superior[3] and inferior,[5] project from the junction of the laminæ and pedicles, and articulating above and below with the articular processes of the adjacent vertebræ. Their superior facets look upwards in the cervical region, outwards in the dorsal, and inwards in the lumbar.

Spinous Process,[1] projects backwards from the junction of the laminæ with each other, sometimes very obliquely.

Fig. 15.



Spinal Foramen,[9] is the space enclosed by the body, pedicles, and laminæ; and which, when the vertebræ are articulated, forms part of the spinal canal.

How are the Vertebræ distinguished? As cervical (7), dorsal (12), and lumbar (5). Each of these divisions has several peculiar features, but their especial characteristics are as follows.

The Cervical Vertebræ are pierced at the bases of their transverse processes by the *vertebral foramina*, which transmit the vertebral artery, vein, and plexus.

The Dorsal Vertebræ have facets and demifacets on their bodies, for articulation with the heads of the ribs.

The Lumbar Vertebræ are marked by the absence of the foramina and facets which distinguish the other two classes.

What are the Peculiar Vertebræ? They are 9 in number,—the atlas or 1st cervical, the axis or 2d cervical, the vertebra prominens or 7th cervical, the 1st, 9th, 10th, 11th, and 12th dorsal, and the 5th lumbar.

The Atlas is a bony ring supporting the head. A bony arch takes the place of a body, and its spinous process is a mere tubercle. Its *Lateral Masses* form its chief bulk, supporting large *Articular Processes* which all look inwards, the superior articulating with the condyles of the occipital bone.

The Axis is marked by its *Odontoid Process* projecting upwards from the body into the anterior part of the spinal foramen of the atlas, where it articulates with the anterior arch, and receives the occipito-axoid and the check ligaments.

The Vertebra Prominens has a long and prominent spinous process which ends in a tubercle for the ligamentum nuchæ.

The Dorsal Vertebræ. The 1st has one facet and a demifacet. The 9th has a demifacet only. The 10th has but one facet on the body and one on the transverse process. The 11th and 12th have each but one facet on the body, and none on the transverse processes. The 12th resembles a lumbar vertebra in size and shape.

The 5th Lumbar is much deeper in front than behind; its spinous process is small, but its transverse processes are large and thick, and point slightly upwards.

What important Relations have Certain Vertebræ?

The 3d Cervical corresponds to—the bifurcation of the common carotid artery, and the superior cervical ganglion.

The 5th Cervical, to—the junctions of the larynx with the trachea, and the pharynx with the œsophagus, and the middle cervical ganglion of the sympathetic.

The 2d Lumbar, to—the junction of the duodenum with the jejunum, the commencement of the thoracic duct and the portal vein, the origin of the superior mesenteric artery, the lower margin of the pancreas, the opening of the ductus communis cholédochus, the lower end of the spinal cord, and the crura of the diaphragm.

[The false vertebræ are described as bones of the pelvis.]

THE THORAX.

What is the Thorax? An osseo-cartilaginous cage formed by the bodies of the dorsal vertebræ posteriorly, the ribs and costal cartilages laterally, and the sternum in front. Its shape is conical, the axis inclined forwards, the base below and closed by the diaphragm.

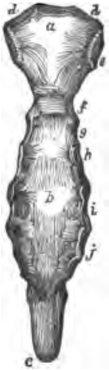
What Structures pass through its Apex? The trachea, œsophagus, large vessels of the neck, pneumogastric, phrenic and sympathetic nerves, thoracic duct, and in inspiration the apex of the lung.

What Structures are contained in its Cavity? The trachea, bronchi and lungs, the heart and great vessels, internal mammary arteries, azygos and bronchial veins, pneumogastric, phrenic, and splanchnic nerves, œsophagus, thoracic duct, lymphatic vessels, and glands.

THE STERNUM.

Describe it. The sternum, or breast-bone, consists of 3 parts,—the manubrium,[a] or handle; the gladiolus,[b] or sword; and the ensiform or xiphoid appendix.[c] It presents the—

FIG. 16.



- *Interclavicular Notch*, on its superior border.
- *Manubrium*,[a] articulates with the clavicle,[d] 1st costal cartilage,[e] and a part of the 2d.[f]
- *Gladiolus*, articulates with the costal cartilages from the 3d to the 6th inclusive, and partly with the 2d and 7th.
- *Ensiform Appendix* (the tip), articulates with the cartilage of the false ribs, and in part with the 7th costal cartilage.[j]

Describe its development and muscles. The sternum is *developed* by 6 centres, 1 each for the manubrium and ensiform appendix, and 4 for the gladiolus. The *muscles* attached to it are 9 pairs and one single muscle,—the sterno-cleido-mastoid, sterno-hyoid, and sterno-thyroid, 3, to its upper part;—the rectus abdominis, external and internal oblique, transversalis, and the diaphragm, 5, to its lower part;—the pectoralis major, 1, anteriorly;—and the triangularis sterni, 1, posteriorly.

THE RIBS.

Describe them. There are 12 ribs on each side, of which 7 are "true ribs," being each connected to the sternum by a separate cartilage;—and 5 are "false ribs." Three of the latter are connected by their cartilages to the cartilage of the 7th rib, while two are called "floating ribs," having each one extremity free.

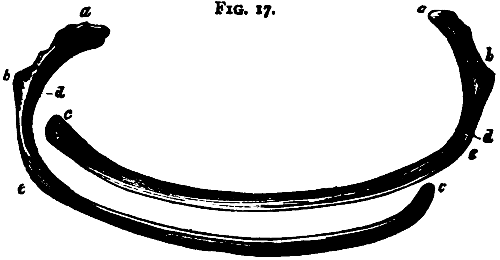
What are the Characteristics Common to most of the Ribs? They each consist of a head, neck, and shaft, and present the following points, viz.—

Head,[a] is divided by a ridge into 2 facets, which articulate with the facets on the bodies of the dorsal vertebræ; the ridge giving attachment to the interarticular ligament.

Neck, about an inch long, having attached to its upper border the anterior costo-transverse ligament, to its posterior surface the middle costo-transverse ligament; its anterior surface is smooth.

Tuberosity,[b] at the junction of the neck with the shaft, has a facet for articulation with the transverse process of the next lower vertebra, and a rough surface for the posterior costo-transverse ligament.

FIG. 17.



Shaft, twisted on itself, is concave internally, convex externally, its upper border round and smooth, its lower border grooved[d] for the intercostal vessels and nerves. At its external extremity[c] is an oval depression for the insertion of the costal cartilage.

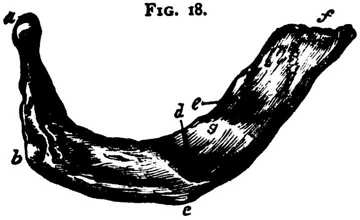
Angle,[e] just in front of the tuberosity, is marked by a rough line, to which are attached the muscles of the deep layer of the back.

How are they developed? Each rib has 3 centres, one each for the head, shaft, and tuberosity. The last 2 ribs, having no tuberosity, are developed each by 2 centres.

Describe the Peculiar Ribs. They are the 1st, 2d, 10th, 11th, and 12th. They respectively present the following peculiarities, viz.—

1st Rib, is broad, short, not twisted, has no angle, only one facet on the head;[a] but on its upper surface are seen *two grooves* for the subclavian artery[d] and vein,[e] and between them a *tubercle*[g] for the scalenus anticus muscle.

FIG. 18.



2d Rib, is not twisted, its tuberosity and angle are very close together, and its upper surface presents rough surfaces for the serratus magnus and scalenus posticus muscles.

10th Rib, has but one facet on its head.

11th Rib, has no neck, no tuberosity, and but one facet on its head.

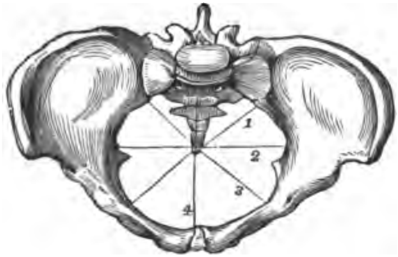
12th Rib, has neither neck, angle, tuberosity nor groove, and but one facet.

THE PELVIS.

Describe the Pelvis. It is formed by the sacrum, coccyx, and two ossa innominata, and is divided into,—the *false pelvis*, comprising the upper and expanded portion,—and the *true pelvis*, below the ilio-pectineal line. The false pelvis corresponds to the iliac fossæ, and is marked by its walls being deficient anteriorly between the iliac borders, and posteriorly between the sacrum and the posterior iliac spines. The true pelvis has a—

Brim, or inlet, bounded in front by the crest and spine of the pubes, behind by the promontory of the sacrum, laterally by the ilio-pectineal line. Its axis corresponds to a line from the umbilicus to the middle of the coccyx. Its average diameters in the female are,—4 inches antero-posteriorly,[4] over 5 inches transversely,[2] under 5 inches obliquely.[3] In the male each of these measurements is about ½ an inch less.

FIG. 19.



Cavity, is a short curved canal, connecting the brim with the outlet. In front its depth is about 1¾ inch, posteriorly 4 to 4½ inches in the female, 4½ to 5½ inches in the male. Its diameter is about 4¾ inches in the female, 4½ inches in the male, all around.

Outlet, is bounded by the pubic arch above, the tip of the coccyx behind, and the tuberosities of the ischii laterally. Its axis, if prolonged, would touch the promontory of the sacrum. Its diameters in the female are each about 4¼ inches, in the male about 3½ inches.

State the chief differences between the male and female pelves. The *male pelvis* is marked by strength of the bones, prominence of the muscular impressions, a deep and narrow cavity, and large obturator foramina. The *female pelvis* has lighter bones, broader iliac fossæ, the spines being further apart, greater diameters at every point, the sacrum less curved, and the pubic arch wider.

Describe the Sacrum. The "sacred bone" is triangular, curved, with its convexity backwards, and is situated base upwards between the ossa innominata, forming with the coccyx the posterior wall of the pelvis. The bone is formed by the coalescence of 5 vertebræ, and presents the following points, viz—

4 *Ridges*,[4] transversely across both surfaces, mark the union of its original segments.

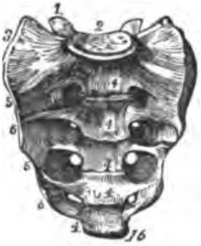
8 *Anterior Sacral Foramina*, for the anterior sacral nerves.

8 *Grooves*,[5] shallow and broad, for the aforesaid nerves.

Promontory, at its junction with the last lumbar vertebræ.

8 *Posterior Sacral Foramina*, for the posterior sacral nerves.

FIG. 20.



Tubercles, representing the spinous processes of the segments.

Groove, posteriorly, on each side of the spinous tubercles.

2 *Cornua*, at the posterior inferior portion of the bone.

Auricular Surface,[3] on each side, articulates with the ilium.

Notch, laterally and inferiorly, for the 5th sacral nerve.

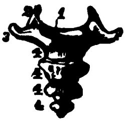
Base,[2] has all the characteristics of the lumbar vertebræ, with the last of which it articulates.

Apex,[16] has an oval surface for articulation with the coccyx.

Sacral Canal, the continuation of the spinal, is incomplete posteriorly at its lower end. It transmits the *Cauda Equina;* into it open the sacral foramina laterally.

Describe the Coccyx. It consists of 4 or 5 rudimentary vertebræ coalesced into a triangular bone, the base[1] of which articulates with the apex of the sacrum. Its posterior surface is rough for muscles and ligaments, its anterior surface is smooth and marked by ridges at the junction of its constituent vertebræ. It presents the following points.—

FIG. 21.



2 *Cornua*,[3] superiorly, articulating with the sacral cornua to form foramina for the 5th sacral nerves.

Apex, is sometimes bifid and turned to one side.

Describe the Ossa Innominata. The unnamed bones are placed one on each side of the osseous pelvis, and are each formed by the union, about puberty, of 3 bones,—the ilium, ischium, and pubes. The innominate bone as a whole presents the following points, viz.—

Acetabulum, or cotyloid cavity, receives the head of the femur. It is situated at the junction of the 3 bones, the ilium and ischium each forming about two-fifths, and the pubes one-fifth of it. A depression in its centre lodges a mass of fat containing vessels for the nourishment of the synovial membrane. The *Cotyloid Notch* is a deficiency in its lower anterior margin, transmitting nutrient vessels to the joint; to the edges of the notch is attached the ligamentum teres, and it is bridged over by the transverse ligament, a continuation of the cotyloid ligament which surmounts the brim of the acetabulum.

Obturator, or Thyroid Foramen,[8] on the anterior surface between the pubes and ischium, large and oval in the male, small and triangular in the female; is closed by the obturator membrane, except above where the obturator nerves and vessels pass through it.

Describe the Ilium. It is the superior part of the innominate bone, and presents the following points, viz.—

Crest,[1] along its upper border, having an outer and inner lip for muscular attachment, and ending in the superior spines.

Anterior Superior Spine,[2] to which is attached the sartorius and tensor vaginæ femoris muscles, and Poupart's ligament.

Anterior Inferior Spine,[4] for the straight tendon of the rectus femoris.

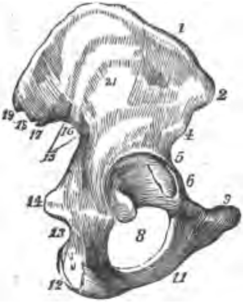
Notch, between the above-named spines, transmitting the external cutaneous nerve, and lodging some fibres of the sartorius.

Posterior Superior Spine,[19] for the attachment of the erector spinæ muscle, and the oblique part of the sacro-sciatic ligament.

Posterior Inferior Spine,[17] for the great sacro-sciatic ligament.

Great Sacro-sciatic Notch,[16] below the last-named spine, transmits the great sciatic, superior gluteal, and pudic nerves, the pyriformis muscle, and the sciatic, pudic, and gluteal vessels, and a nerve supplying the obturator externus muscle.

FIG. 22.



Curved Lines,[21] superior middle and inferior, on the outer surface of the bone, from the spaces between which arise the glutei muscles.

Groove, above the acetabulum, for the reflected tendon of the rectus femoris muscle.

Linea Ilio-pectinea, in part; on the inner surface, above which is a smooth surface, the *Venter of the Ilium.*

Auricular Surface,[18] rough, articulates with the sacrum.

Describe the Ischium. It is the lowermost portion of the innominate bone, and presents the following points, viz.—

Body, forms two-fifths of the acetabulum, and the external margin of the obturator foramen; on it is a broad groove for the tendon of the obturator externus muscle. Its posterior margin assists in forming the great sacro-sciatic notch.

Spine,[14] for the gemellus superior, coccygeus, and levator ani muscles, and the lesser sacro-sciatic ligament.

Lesser Sacro-sciatic Notch,[13] below the spine, transmits the obturator muscle, its nerve, and the pudic vessels and nerve as they re-enter the pelvis, having crossed the spine of the ischium. The sacro-sciatic notches are converted into foramina by the sacro-sciatic ligaments; the greater notch by the lesser ligament, the lesser notch by the greater ligament.

Tuberosity,[12] the lowest and most prominent part, gives attachment to the greater sacro-sciatic ligament, and to several muscles. On it one rests when sitting.

Ascending Ramus, bounds the obturator foramen inferiorly, articulates with the descending ramus of the pubes, and gives attachment to the obturator membrane and several muscles.

Describe the Pubes. The pubic or pectineal bone forms the anterior portion of the innominate. It presents the following, viz.—

Body, lies between the rami, with its fellow forms the *Symphysis,* giving origin to several muscles and ligaments.

Crest,[9] is the upper part of the body, terminates externally in the *Spine,* and internally in the *Angle.*

Spine, affords attachment to one end of Poupart's ligament.

Linea Ilio-pectinea, in part; gives attachment to the conjoined tendon, Gimbernat's ligament, and the triangular ligament.

Horizontal Ramus, forms part of the brim of the pelvis, of the margin of the obturator foramen, and of the acetabulum. On its under surface is a groove for the obturator vessels and nerve.

Pectineal Eminence,[5] gives attachment to the psoas parvus muscle.

Descending Ramus,[11] flat and thin, joins the ascending ramus of the ischium, and bounds the obturator foramen internally.

What Muscles are attached to the Os Innominatum? 36, comprising those of the abdomen, thigh, perineum, floor of the pelvis, and rotators of the hip-joint.

BONES OF THE UPPER EXTREMITY.

THE SHOULDER.

What Bones form the Shoulder? The clavicle and scapula connecting the arm with the trunk, and in this respect homologous to the innominate bone in the lower part of the body.

Describe the Clavicle. The collar- or key-bone, is a short bone by structure, having no medullary canal; and is curved like the letter *f*, its inner two-thirds being cylindrical, and convex anteriorly; its outer third flattened, and concave anteriorly. It is placed horizontally between the sternum and the scapula, and is the most elastic bone in the body. It presents, from within outwards, the following points, viz.—

Facets, for articulation with the sternum and the cartilage of the 1st rib, at its sternal end.
Impression for the rhomboid, or costo-clavicular ligament.
Groove, on the lower surface, for the subclavius muscle.
Tubercle, for the conoid part of the costo-clavicular ligament.
Oblique Line, for the trapezoid part of the same ligament.
Facet, on the acromial end, for articulation with the scapula.
Nutrient Foramen, in the subclavian groove.

Describe the Scapula. The shoulder-blade is a large, flat, and triangular bone, situated on the posterior and lateral portion of the thorax, from the 2d rib to the 7th, inclusive.

THE VENTER, or anterior surface, presents from within outwards,—

Ridges, giving attachment to the subscapularis muscle.
Marginal Surface, along the inner border, for the attachment of the serratus magnus muscle.
Subscapular Fossa, and Angle, for the subscapularis muscle.

THE DORSUM, or posterior surface, presents the following, viz.—

Spine, a bony ridge, which affords attachment to the trapezius and deltoid muscles, and ends in the acromion process.
Supraspinous Fossa, above the spine, for the supraspinatus muscle.
Infraspinous Fossa, below the spine, larger than the supraspinous, convex at its centre, lodges the infraspinatus muscle, and the nutrient foramen.
Marginal Surface, along the external border, to which are attached the teres minor muscle above, the teres major below, and sometimes a few fibres of the latissimus dorsi at the lower angle.
Groove crossing the margin, for the dorsalis scapulæ vessels.
Smooth Surface, behind the root of the spine, over which the trapezius muscle glides.

THE ACROMION PROCESS, or "summit of the shoulder," extends from the spine, and projects over the glenoid cavity, articulating with the clavicle by an oval facet. It affords attachment to the deltoid and trapezius muscles, and by its apex to the coraco-acromial ligament.

THE CORACOID PROCESS, or "crow's beak," projects from the upper border and neck of the bone over the inner and upper part of the glenoid cavity.

Into it is inserted 1 muscle, the pectoralis minor; the coraco-brachialis, and the short head of the biceps arise from it by a common tendon; and 3 ligaments are attached to it,—the conoid, trapezoid, and coraco-acromial.

THE SUPERIOR BORDER presents the—

Suprascapular Notch, converted into a foramen for the suprascapular nerve by the transverse ligament, over which passes the suprascapular artery. The omo-hyoid muscle is attached to the border just internal to the notch.

THE AXILLARY BORDER is the thickest, and presents a—

Rough Surface, for the long head of the triceps muscle, just below the glenoid cavity.

Groove, the origin of a part of the subscapularis muscle.

THE VERTEBRAL BORDER is the longest, and presents an—

Anterior Lip, for the attachment of the serratus magnus.

Posterior Lip, for the supra- and infra-spinatus muscles.

Interspace, between the lips, for the levator anguli scapulæ, the rhomboideus minor, and the fibrous arch of the rhomboideus major muscles.

OTHER POINTS of interest on the bone are the—

Superior Angle, affords attachment to part of the serratus magnus, levator anguli scapulæ, and supra-spinatus muscles.

Inferior Angle, affords attachment to part of the serratus magnus and teres major muscles, and occasionally to a few fibres of the latissimus dorsi.

Glenoid Cavity, at the external angle or head of the bone, a shallow cavity for the reception of the head of the humerus. It is deepened by the glenoid ligament which is attached around its margin; and at its upper part gives origin to the long head of the biceps flexor cubiti muscle.

Neck, is the contracted part of the bone behind the glenoid cavity; from it arises the anterior root of the coracoid process.

THE ARM.

Describe the Humerus. It is the only bone in the arm, and articulates with the scapula above, and with the ulna and radius below. It presents the following points, viz.—

Head,[b] is nearly hemispherical, and smooth for articulation with a glenoid cavity of the scapula.

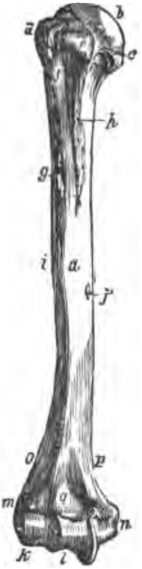
Anatomical Neck,[c] is a constriction in the bone, just below the head, for the attachment of the capsular ligament.

Greater Tuberosity,[d] has 3 small facets for the insertions of the supraspinatus, infraspinatus, and teres minor muscles.

Lesser Tuberosity,e on the inner side of the bone, gives insertion to the subscapularis muscle.

Bicipital Groove,f lies vertically between the tuberosities for the upper third of the bone, and lodges the tendon of the long head of the biceps flexor cubiti. Into its inner or posterior lip *h* are inserted the teres major and latissimus dorsi muscles, while its outer or anterior lip *g* receives the insertion of the tendon of the pectoralis major, which covers the groove.

FIG. 23.



Surgical Neck, is situated immediately below the tuberosities, and is a slight constriction in the upper part of the shaft.

Shaft,a is cylindrical above, prismatic and flattened below.

Rough Surface,i for the insertion of the deltoid muscle, about the middle of the external surface of the shaft.

Musculo-spiral Groove, lodging the musculo-spiral nerve, and the superior profunda artery, is situated on the posterior surface of the shaft, separating the origins of the outer and inner heads of the triceps muscle.

Orificej of the nutrient canal, about the middle of the shaft.

Condyloid Ridges,op internal and external, arising from the respective condyles, extending upwards along the shaft.

External Condyle,m gives attachment to the external lateral ligament and the extensor and supinator group of muscles.

Internal Condyle,n lower and more prominent than the other, gives attachment to the internal lateral ligament and the flexor and pronator group of muscles of the fore-arm.

Radial Head,k forms the external part of the inferior articular surface; for articulation with the radius.

Trochlear Surface,l articulates with the greater sigmoid cavity of the ulna; is a deep depression between two borders, and extends from the anterior to the posterior surface of the bone.

Coronoid Fossa,q in front of the trochlea, receives the coronoid process of the ulna when the fore-arm is flexed.

Olecranon Fossa, behind the trochlea, receives the tip of the olecranon process, when the fore-arm is extended.

THE FORE-ARM.

Describe the Ulna. The elbow-bone is the internal bone of the fore-arm. It is larger and longer than the radius, forming the greater portion of the articulation with the humerus. It does not enter into the formation of the wrist-joint, being excluded therefrom by an interarticular fibro-cartilage. It presents the following, viz.—

Olecranon Process,[d] at the upper extremity, forming the elbow. It is curved forwards, its apex being received into the olecranon fossa of the humerus when the fore-arm is extended. Its posterior surface gives insertion to the tendon of the triceps. In its function and structure it resembles the patella.

Coronoid Process,[e] below the olecranon, projects forwards, its apex being received into the coronoid fossa of the humerus when the fore-arm is flexed. Its upper surface is concave for articulation with the humerus, its lower surface rough for the insertion of the brachialis anticus muscle. Its inner surface has a margin for the internal lateral ligament, a tubercle for the flexor sublimis digitorum, and a ridge for the pronator radii teres.

Greater Sigmoid Cavity,[b] lies between the processes, and is divided by a vertical ridge into two unequal parts. It articulates with the trochlear surface of the humerus.

Lesser Sigmoid Cavity[c] lies external to the coronoid process; is oval and concave, articulating with the head of the radius, and giving attachment to the orbicular ligament.

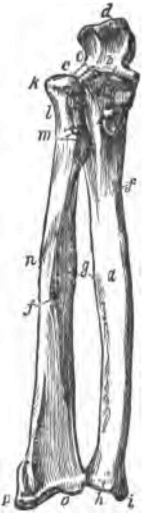
Shaft,[a] large and prismatic above, smaller and rounded below, has the *Nutrient Foramen*[f] on its anterior surface, and a prominent margin[g] externally, to which is attached the interosseous membrane. The shaft gives attachment to 9 of the 12 muscles of the fore-arm.

Head,[h] at the carpal end, articulates with the lesser sigmoid cavity of the radius, and the fibro-cartilage of the wrist-joint.

Styloid Process,[i] projecting from the head internally and posteriorly, its apex gives attachment to the internal lateral ligament, and a depression at its root to the fibro-cartilage of the joint.

Groove, for the tendon of the extensor carpi ulnaris muscle.

FIG. 24.



Describe the Radius. The radius lies externally to the ulna when the fore-arm is in supination; it is prismatic in form with the base below where it articulates with the carpus. The bone is curved outwards and is shorter than the ulna, by the length of the olecranon. It presents the following points from above downwards, viz.—

Head,^{k} cylindrical and cup-shaped, articulating with the radial head of the humerus, and the lesser sigmoid cavity of the ulna, and playing within the orbicular ligament.

Neck,^{l} the constricted part below the head.

Tuberosity,^{m} rough behind for the insertion of the biceps, and smooth in front where it is covered by a bursa.

Shaft,^{j} prismoid in form, presents a sharp border internally for the attachment of the interosseous membrane; the *Nutrient Foramen* is on its anterior surface. It gives attachment to 8 of the 12 muscles of the fore-arm.

Sigmoid Cavity, at the internal side of the carpal end, is shallow, and articulates with the head of the ulna.

Articular Surface,^{o} is divided by a ridge into 2 facets for articulation with the semilunar and scaphoid bones of the carpus.

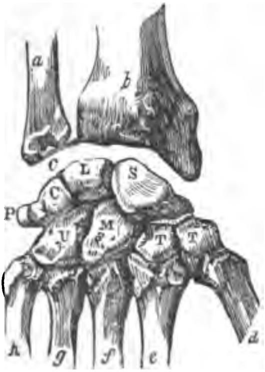
Styloid Process,^{p} externally, gives attachment by its apex to the external lateral ligament, and by its base to the supinator longus muscle.

Grooves, on the posterior and external surfaces of the lower extremity, for the tendons of the 8 extensor muscles of the thumb, and those of the radial side of the wrist, and fingers.

THE HAND.

How are the Bones of the Hand divided? Into the carpus (8), the metacarpus (5), and the phalanges (14). Total, 27 bones.

FIG. 25.



Name the Bones of the Carpus. They are placed in 2 rows, one row in front of the other, with 4 bones in each row, as follows,—the left hand being in supination, naming from without inwards, viz.—

1st, or Proximal Row,—Scaphoid,^{S} Semilunar,^{L} Cuneiform,^{C} Pisiform.^{P}

2d, or Distal Row,—Trapezium,^{T} Trapezoid,^{T} Os-magnum,^{M} Unciform.^{U}

State the number of Articulations in the Carpus. 34, as follows,—the number after each bone representing the number of its articulations, viz.—

Scaphoid, 5. Semilunar, 5. Cuneiform, 3. Pisiform, 1.
Trapezium, 4. Trapezoid, 4. Os-magnum, 7. Unciform, 5.

What peculiarities have the Carpal bones? The first three enter into the formation of the wrist-joint; the pisiform does not, but is wholly without it, and may be considered a mere appendage of the carpus. When the hand is in pronation—

The Scaphoid, or boat-shaped bone, has a tuberosity on its outer side, its largest auricular facet is uppermost, and a transverse groove crosses its posterior surface.

The Semilunar Bone has a crescentic facet externally, and a convex facet superiorly.

The Cuneiform Bone is wedge-shaped, its convex surface above, and has an isolated facet for the pisiform articulation.

The Pisiform Bone is the smallest, and has but one facet, which lies posteriorly when the bone is in position.

The Trapezium has a deep groove for the tendon of the flexor carpi radialis, and a saddle-shaped facet, inferiorly.

The Trapezoid is small and quadrilateral, bent on itself, with a saddle-shaped facet looking downwards.

The Os-magnum has a head looking upwards, a neck, and a body; is the largest bone of the carpus, and has a tubercle on the inner side of the base.

The Unciform Bone is triangular, with a concavity which lies to the outer side; and the unciform process, long and curved, projecting from its palmar surface.

Describe the Metacarpus. The 5 metacarpal bones are placed between the carpus and the phalanges, are long bones, and each has a head, shaft, and base. Their heads articulate with the respective phalanges.

1st Metacarpal Bone,[d] articulates with the trapezium, is shorter than the others by one-third, and its base has but 1 articular facet. This bone is classed among the phalanges by Professor W. H. Pancoast.

2d Metacarpal Bone,[e] articulates with 3 bones of the carpus,—the trapezium, trapezoid, and os-magnum; its base is large, and has 4 articular facets.

3d Metacarpal Bone,[f] articulates with 1 bone of the carpus,—the os-magnum; its base has a projecting process on the radial side, and 2 small facets on the opposite side.

4th Metacarpal Bone,[g] articulates with 2 bones of the carpus and with the adjacent metacarpal bones; its base is small, and has 2 circular facets, 1 on each side.

5th Metacarpal Bone,[h] articulates with 1 carpal bone,—the unciform; its base has 1 lateral articular facet.

LANE

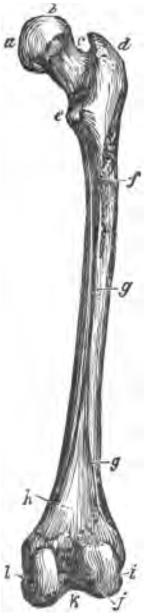
Describe the Phalanges. The finger-bones are 14 in number (15 according to Pancoast), 3 to each finger, and 2 to the thumb. They are long bones, and each has a base, a shaft, and a digital extremity. The *Bases* of the first row articulate with the heads of the metacarpal bones. The *Digital Extremities* of the first and second rows have each 2 small lateral condyles, while in the terminal row they are rough, for the attachment of the sensitive pulp of the fingers.

BONES OF THE LOWER EXTREMITY.

THE THIGH.

Describe the Femur. The thigh-bone is nearly cylindrical, and is the longest, largest, and strongest bone in the body. In the vertical position of the skeleton it forms one side of a triangle, of which the base is the breadth of the pelvis, and the apex at the knee-joints. The base of this triangle is longest in the female, and consequently that sex is usually knock-kneed.

FIG. 26.



- *Head,*[b] articulates with the acetabulum, forms about two-fifths of a sphere, and has an oval depression[a] below its centre for the attachment of the ligamentum teres.
- *Neck,*[c] connects the head with the shaft, is pyramidal and flattened; its obliquity varies with age, being less before puberty, about 120 to 125 degrees in the adult, and nearly horizontal to the shaft in old or debilitated subjects.
- *Great Trochanter,*[d] a broad, rough, quadrilateral process directed outwards and backwards from the summit of the shaft to within three-fourths of an inch of the level of the head. On its outer surface the tendon of the gluteus maximus plays over a bursa. It gives insertion to the obturator internus, two gemelli, pyriformis, and gluteus minimus and medius muscles.
- *Digital Fossa,* on the inner surface of the great trochanter, gives insertion to the obturator externus muscle.
- *Lesser Trochanter,*[e] at the inferior root of the neck posteriorly, is small and conical, and affords insertion to the tendon of the psoas magnus muscle, the tendon of the iliacus being inserted immediately below it.
- *Inter-trochanteric Lines,* anterior and posterior, the latter the most prominent; to the anterior is attached the capsular ligament of the hip-joint.
- *Linea Quadrati,* extends from the middle of the posterior inter-trochanteric line about 2 inches down the shaft, and gives attachment to the quadratus femoris muscle.

Shaft, is slightly curved forwards, broad and cylindrical at each end, and narrow and triangular in the centre. Its nutrient foramen perforates its posterior surface below the centre. From its anterior surface arise the crureus and sub-crureus muscles.

Linea Aspera,[gg] a crest lying along the central third of the shaft posteriorly; bifurcating above towards each trochanter, also below towards the 2 condyles. To its outer lip is attached the vastus externus, to its inner lip, the vastus internus; and between them, the pectineus, adductor brevis, and gluteus maximus above the short head of the biceps below, and the adductors longus and magnus along the greater portion of the space.

Groove, crossing the internal condyloid ridge, and lodging the femoral artery.

Popliteal Space,[h] triangular and smooth, lying between the condyloid ridges, for the popliteal artery.

External Condyle,[i] broader and shorter than the internal, so as to form a horizontal articulation, the bone being inclined towards the median line. It gives attachment to the external lateral ligament, and the popliteus and gastrocnemius muscles.

Internal Condyle,[l] the longest by half an inch; it gives attachment to the internal lateral ligament and the gastrocnemius muscle.

Inter-condyloid Notch,[k] lodges the crucial ligaments. In front the condyles are continuous with each other, forming a concave depression or trochlea for the patella.

Outer Tuberosity, on the external condyle, for the attachment of the external lateral ligament.

Groove, below the outer tuberosity, for the tendon of the popliteus muscle, terminating in a depression whence the muscle takes its origin.

Inner Tuberosity, on the internal condyle, for the attachment of the internal lateral ligament.

Tubercle, above the inner tuberosity, for the insertion of the tendon of the adductor magnus muscle.

Depression, behind the tubercle, for the tendon of the inner head of the gastrocnemius.

THE LEG.

Describe the Tibia. The shin-bone ranks next to the femur in respect to size and length. Its form is prismoidal, the upper extremity being much larger than the lower.

Head, expands into 2 lateral tuberosities,[bc] which articulate with the condyles of the femur.

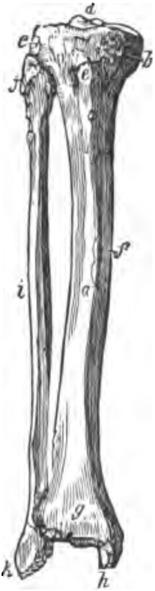
Spine,[d] projects vertically between the 2 articular surfaces, is bifid, affording attachment to the semilunar fibro-cartilages, and by depressions in front and behind its base to the crucial ligaments of the joint.

Tubercle,[e] anteriorly on the head, between the tuberosities, for the insertion of the ligamentum patellæ.

Popliteal Notch, posteriorly between the tuberosities, affords attachment to the posterior crucial ligament.

Groove, on the inner tuberosity posteriorly, for the insertion of the tendon of the semi-membranosus muscle.

FIG. 27.



Facet, on the outer tuberosity posteriorly and looking downwards, for articulation with the head of the fibula.

Popliteal Line, obliquely across the upper part of the shaft posteriorly, affords attachment to the fascia of the popliteus, and parts of the soleus, flexor longus digitorum, and tibialis posticus muscles.

Nutrient Canal, the largest in the skeleton, opens just below the popliteal line, its orifice looking upwards.

Shaft,[a] has 3 sharp ridges,—1 in front, the *Crest* or *Shin,*[f] and 1 on either side, to the external of which is attached the interosseous membrane.

Lower Extremity,[g] is smaller than the upper, grooved posteriorly for the tendon of the flexor longus pollicis; externally has a rough triangular depression for articulation with the fibula, and for the attachment of the inferior interosseous ligament. Its inferior surface is concave and smooth for articulation with the upper surface of the astragalus.

Internal Malleolus,[h] projects downwards from the internal side of the lower extremity. It articulates with the astragalus, is grooved posteriorly for the tendons of the tibialis posticus and flexor longus digitorum muscles, and affords attachment to the internal lateral ligament.

Describe the Fibula. It is a long slender bone, placed nearly parallel with the tibia on the outer side of the leg. It is also called the peroneous, or peroneal bone.

Head,[j] articulates with the external tuberosity of the tibia by a flat facet. Externally it has a prominence for the attachment of the long external lateral ligament of the knee-joint.

Styloid Process, projects upwards from the head posteriorly, and gives insertion to the tendon of the biceps muscle, and the short external lateral ligament of the knee-joint.

Shaft[i] is triangular and twisted on itself, having 3 marked ridges, the innermost of which is sharp for the attachment of the interosseus membrane. The shaft arches backwards, and gives attachment to 8 of the 12 muscles of the leg.

Nutrient Canal, opens about the centre of the shaft posteriorly, its orifice looking downwards.

External Malleolus,^{k} is the lower extremity of the bone. It is larger and longer than the internal, articulates with the astragalus by a triangular facet, and is grooved posteriorly for the tendons of the peroneus longus and brevis muscles. Its edge affords attachment to the external lateral ligament of the ankle-joint.

THE FOOT.

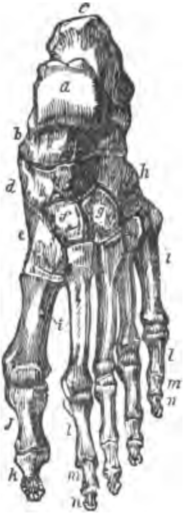
How are the bones of the Foot divided? Into the tarsus (7), metatarsus (5), and phalanges (14). Total, 26 bones.

Name the bones of the Tarsus. They are placed in 2 rows side by side, 2 bones in the external row, 5 in the internal, as follows- viz.—

Internally,—	Astragalus.^{a}	Scaphoid.^{d}	3 Cuneiform.^{efg}
Externally,—	Os calcis.^{c}	Cuboid.^{h}	

How many Articulations are in the Tarsus? 28, each bone articulating with 4 others, except the os calcis, which articulates with 2, and the external cuneiform with 6 bones.

FIG. 28.



What Peculiarities have the Tarsal Bones? They may be divided transversely at the astragalo-scaphoid-calcaneo-cuboid articulation, the site of Chopart's operation.

The Astragalus,^{a} has a rounded head, a convex surface on which is a broad articular facet, and on its inferior surface a deep groove between 2 articular facets.

The Os Calcis,^{c} is a large bone, having on its upper surface a deep groove for the interosseous ligament, between 2 articular surfaces; anteriorly a large irregular portion, the head; and posteriorly an elongated portion forming *the Heel.* On its internal surface is a projection, the *Sustentaculum Tali,* which supports the internal articulating surface; below which process the bone is deeply grooved for the plantar vessels and nerves and the flexor tendons. To the os calcis are attached 8 muscles and the plantar fascia.

The Scaphoid Bone,[d] is boat-shaped, has 3 facets anteriorly for the cuneiform bones, a concave surface posteriorly for the astragalus, and a facet externally for the cuboid bone. A tubercle is situated on the lower surface internally, for the insertion of the tibialis posticus muscle.

The Cuboid Bone,[h] has 3 articular surfaces, and a groove inferiorly for the tendon of the peroneus longus.

The Internal Cuneiform Bone,[e] the largest of the 3, has a tubercle on its plantar surface for the insertion of parts of the tendons of the tibialis anticus and tibialis posticus muscles.

The Middle Cuneiform Bone,f is small and wedge-shaped with the narrow end downwards. Its anterior surface is considerably behind the line of the tarso-metatarsal articulation, thus forming a recess into which the base of the second metatarsal bone fits.

The External Cuneiform Bone,g is also wedge-shaped, but longer than the middle one; and affords origin to 1 muscle, the flexor brevis pollicis.

Describe the Metatarsus. The metatarsal bones[i] are 5 in number, are long bones, having each a shaft and 2 extremities. Their bases articulate with the tarsal bones and with each other; their heads with the first row of phalanges.

1st Metatarsal, is large but shorter than the others, and forms the inner border of the foot, articulating with the internal cuneiform.

2d Metatarsal, is the longest; its base has 3 facets for articulation with the 3 cuneiform bones in the recess formed by the shortness of the middle cuneiform.

3d Metatarsal, has 2 facets on the inner side of its base, besides the facets for the internal cuneiform and the 4th metatarsal bone.

4th Metatarsal, articulates with the cuboid bone, and also with the internal cuneiform.

5th Metatarsal, articulates obliquely with the cuboid bone, and has a tubercular projection on the outer surface of its base, which forms the guide to Hey's operation.

Describe the Phalanges of the Foot. They number 14 as in the hand, the great toe having 2, the other toes 3 each. They are long bones, each having a base, a shaft, and an anterior extremity. They are convex above, concave below, and articulate by the bases of the first row with the bones of the metatarsus. The anterior extremities of the distal phalanges[k,n] are expanded into surfaces for the support of the nails and pulp of the toes.

THE ARTICULATIONS.

Into what Classes are the Articulations divided? Into 3,—1. *Synarthro'sis*, immovable; 2. *Amphiarthro'sis, Synchondrosis, or Symphysis*, having limited motion; 3. *Diarthro'sis*, having free motion.

How are the Synarthroses subdivided? Into 3 divisions,—*Sutura*, by indentations; *Schindy'lesis*, by a plate of bone into a cleft in another; and *Gompho'sis*, by a conical process into a socket. The *Sutura* are again subdivided into—*S. Dentata*, having tooth-like processes; *S. Serrata*, with serrated edges; *S. Limbosa*, having beveled margins and dentated processes; *S. Squamosa*, with thin beveled margins overlapping each other; *S. Harmonia*, contiguous rough surfaces opposed to each other. The first 3 are also named *Sutura Vera* (true sutures) having indented borders; the last 2 *Sutura Notha* (false sutures) being formed by rough surfaces.

How are the Diarthroses divided? Into 4 divisions,—*Arthrodia*, gliding joint; *Enarthrosis*, ball-and-socket joint; *Ginglymus*, hinge-joint; and *Diarthrosis Rotatorius*, a ring surrounding a pivot.

Give an Example of each of the above-named articulations.

Synarthro'sis,—bones of cranium and face, except the lower jaw.
  Sutura Dentata,—the inter-parietal suture.
  Sutura Serrata,—the inter-frontal suture.
  Sutura Limbosa,—the fronto-parietal suture.
  Sutura Squamosa,—the tempora-parietal suture.
  Sutura Harmonia,—the intermaxillary symphysis.
  Schindy'lesis,—rostrum of sphenoid with the vomer.
  Gompho'sis,—the teeth in their alveoli.
Amphiarthro'sis,—the bodies of the vertebræ, the sacro-iliac, and pubic symphyses.
Diarthro'ses,—
  Arthrodia,—sterno-clavicular articulation.
  Enarthrosis,—hip-joint, shoulder-joint.
  Ginglymus,—elbow-joint, ankle-joint, knee-joint.
  Diarthrosis Rotatorius,—the superior radio-ulnar, and atlo-axoid articulations.

Name the Varieties of motion in joints? There are 7 varieties, viz.—flexion, extension, adduction, abduction, rotation, circumduction, and gliding movement.

What Structures enter into the formation of joints? There are 5, viz.—the articular lamella of bone, ligaments, cartilage, fibro-cartilage, and synovial membrane.

Articular Lamella of bone differs from ordinary bone tissue in being more dense, containing no Haversian canals nor canaliculi, and having larger lacunæ.

Ligaments are bands of white fibrous tissue, except the ligamentum subflava and the ligamentum nuchæ, which are both composed purely of yellow elastic tissue.

Cartilage is temporary or permanent. The first forms the original framework of the skeleton, and becomes ossified. Permanent cartilage is not prone to ossification, and is divided into 3 varieties,—*Articular*, covering the ends of bones in joints; *Costal*, forming part of the skeleton; *Reticular*, arranged in lamellæ or plates to maintain the shape of certain parts.

Fibro-cartilage is *Interarticular* (menisci), separating the bones of a joint; *Connecting*, binding bones together; *Circumferential*, deepening cavities; *Stratiform*, lining grooves.

Synovial Membranes secrete the synovia, a viscid, glairy fluid, and resemble the serous membranes in structure. They are *Articular*, lubricating joints; *Bursal*, forming closed sacs (bursæ); *Vaginal*, ensheathing tendons.

Describe the Vertebral Articulations. They are formed by the adjacent surfaces of the bodies of the vertebræ, and their articular processes, and are connected by the following ligaments, etc.—(See FIG. 31.)

Intervertebral Fibro-cartilages, between the bodies of all true vertebræ, except the axis and atlas.

Anterior Common Ligament,[1] along fronts of the bodies.

Posterior Common Ligament, along backs of the bodies.

Ligamenta Subflava, connect the laminæ of adjacent vertebræ.

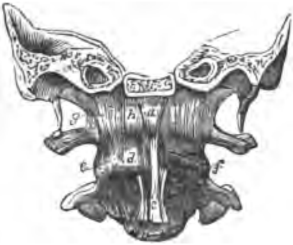
Capsular,[4] surround the articular processes, and are lined by synovial membrane.

Supra-spinous and Inter-spinous, connect the spinous processes.

Inter-transverse,[3] connect the transverse processes.

Describe the Occipito-atloid Articulation. It is a double arthrodia formed by the condyles of the occipital bone with the superior articular surfaces of the atlas, and has 7 ligaments, viz.—

FIG. 29.



2 *Anterior Occipito-atloid*,[a] from the anterior margin of the foramen magnum to the anterior arch of the atlas.

Posterior Occipito-atloid, from the posterior margin of the foramen magnum to the posterior arch of the atlas. It is perforated by the vertebral arteries and suboccipital nerves.

2 *Lateral,* from the jugular processes of the occipital bone to the bases of the transverse processes of the atlas.

2 *Capsular,*[d] around the articular surfaces, lined by synovial membrane.

Describe the Occipito-axoid Articulation. Formed by the occipital bone and the odontoid process of the axis, which do not articulate with each other strictly, but are connected by 4 ligaments.

Occipito-axoid[1] (*Apparatus Ligamentosus Colli*), a continuation of the posterior common spinal ligament to the basilar process of the occipital bone.

2 *Lateral Occipito-odontoid*[b] (*Check Ligaments*), from the head of the odontoid process to the sides of the occipital condyles.

Vertical Occipito-odontoid (*Ligamentum Suspensorium*), from the anterior margin of the foramen magnum to the odontoid apex.

Describe the Atlo-axoid Articulation. It is a double arthrodia between the articular processes, a double diarthrosis rotatorius between the atlas and the odontoid process, and has 6 ligaments, and 4 synovial membranes.

2 *Anterior and 1 Posterior Atlo-axoid,* continuations of the anterior and posterior common spinal ligaments.

2 *Capsular,* surrounding the articular surfaces, each lined by a synovial membrane.

Transverse, or Cruciform Ligament, divides the spinal foramen of the atlas into two portions, stretching across between the tubercles on the inner sides of the articular processes. It holds the odontoid process in place, having a synovial membrane interposed. Another synovial membrane is situated between the process and the anterior arch. The transverse ligament sends two vertical slips, one upwards, the other downwards, from which it is named the *Cruciform Ligament.*

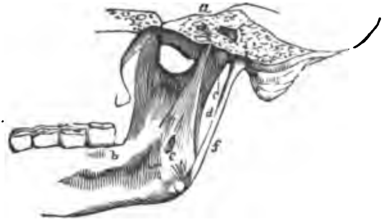
Describe the Temporo-maxillary Articulation. A double arthrodia between the condyle of the lower jaw and the anterior part of the glenoid cavity of the temporal bone. It has 2 synovial membranes with an inter-articular fibro-cartilage between them, and 4 ligaments, viz.—

External Lateral, from the tubercle of the zygoma to the outer side of the neck of the condyle of the lower jaw.

Internal Lateral,[d] from the spine of the sphenoid to the margin of the inferior dental foramen.

Stylo-maxillary,[f] from the styloid process of the temporal bone to the angle of the inferior maxillary.

FIG. 30.



Capsular,c from the edge of the glenoid cavity and the eminentia articularis to the neck of the inferior maxillary condyle.

Nerves are derived from the auriculo-temporal and masseteric branches of the inferior maxillary.

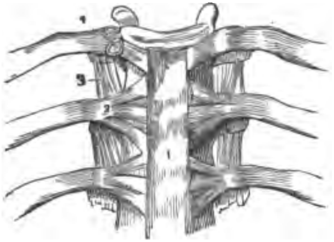
Describe the Costo-vertebral Articulations. They are each a double arthrodia between the head of the rib and the bodies of 2 adjacent vertebræ, except in the 1st, 10th, 11th, and 12th ribs, which are each a single arthrodia, as they articulate with but 1 vertebra each. Their ligaments are 3, viz.—

Anterior Costo-vertebral,[2] *or Stellate Ligament*, consists of 3 bundles, which fasten the anterior part of the head of the rib to the intervertebral disk and the 2 adjacent bodies.

Inter-articular Costo-vertebral, in the interior of the joint, from the crest on the head of the rib to the intervertebral disk; on each side there is a separate synovial membrane.

Capsular, surrounding the articular surfaces.

FIG. 31.



Describe the Costo-transverse Articulations. They are 10 arthrodial articulations between the tubercles of the first 10 ribs and the transverse processes of the vertebræ next below. Their ligaments are 3, viz.—*Anterior, Middle, and Posterior Costo-transverse.*

Describe the Costo-sternal Articulations. One a synarthrodial, 6 are arthrodial articulations, between the costal cartilages and the margin of the sternum. The first has no synovial membrane, the second only has an inter-articular fibro-cartilage. Each has 3 ligaments,—the *Anterior and Posterior Costo-sternal*, and a *Capsular*. The *Costo-xiphoid Ligament* connects the xiphoid appendix to the cartilage of the 6th or 7th rib.

How are the Costal Cartilages connected with the ribs and with each other? With the ribs by a depression on the end of each rib, strengthened by the blending together of the periosteum and the perichondrium. The cartilages of the lower ribs, sometimes from the 5th to the 10th inclusive, articulate with each other by their borders and for each a capsular and an intercostal ligament, with 3 synovial membranes for the 3 articulations between the 6th and the 9th cartilages.

What are the Ligaments of the Sternum? An anterior sternal and a posterior sternal ligament, with a layer of cartilage between the manubrium and the gladiolus.

Describe the Sacro-vertebral Articulation. It is similar to the other vertebral articulations, but has 2 additional ligaments on each side, viz.—

Lumbo-sacral, from the transverse processes of the 5th lumbar vertebra to the base of the sacrum laterally and anteriorly.

Lumbo-iliac, from the apices of the transverse processes of the 5th lumbar vertebra to the crest of the ilium.

Describe the Sacro-coccygeal Articulation. It is an amphiarthrodial joint, and has 3 ligaments, viz.—

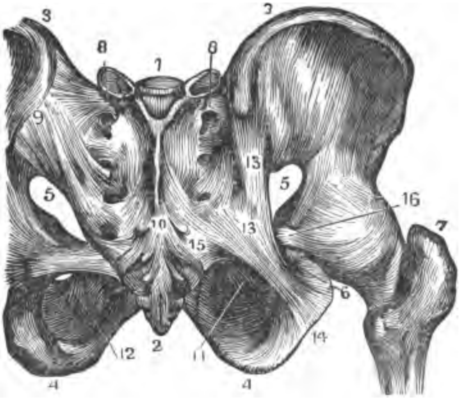
Anterior Sacro-coccygeal. *Posterior Sacro-coccygeal.*
Interarticular Fibro-cartilage, in the joint.

Describe the Sacro-iliac Articulation. It is an amphiarthrodial joint, formed by the auricular surfaces of the sacrum and ilium. Its ligaments on each side are as follows, viz.—

Anterior Sacro-iliac. *Posterior Sacro-iliac.*[8]
Oblique Sacro-iliac.

Describe the Sacro-ischiatic Articulation. Its ligaments convert the sacro-sciatic notches into foramina, the greater notch by the lesser ligament, the lesser notch by the greater ligament. These foramina are described under the ilium and ischium bones.

FIG. 32.



Great Sacro-sciatic Ligament,[13] [14] from the posterior inferior spine of the ilium and the posterior surfaces and margins of the sacrum and coccyx, to the inner margin of the tuberosity and the ascending ramus of the ischium.

Lesser Sacro-sciatic Ligament,[15] [16] from the margins of the sacrum and coccyx, into the spine of the ischium.

Describe the Pubic Articulation. It is an amphiarthrodial joint, formed by the 2 pubic bones. It has an interarticular fibro-cartilage and 4 ligaments, viz.—

Anterior Pubic. *Posterior Pubic.* *Supra-pubic.*
Sub-pubic, forming a fibrous arch between the rami.

Describe the Sterno-clavicular Articulation. It is an arthrodial joint, formed by the sternal end of the clavicle with the sternum and the cartilage of the 1st rib. It has an interarticular fibro-cartilage, 2 synovial membranes, and 4 ligaments, viz.—

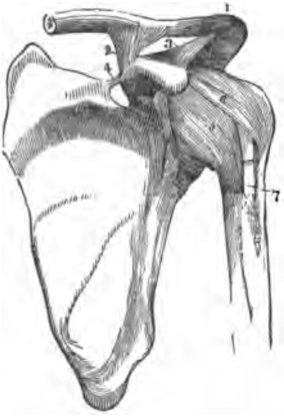
Anterior Sterno-clavicular.
Posterior Sterno-clavicular.
Interclavicular.
Costo-clavicular or Rhomboid.

Describe the Scapulo-clavicular Articulation. It is an arthrodial joint, formed by the outer extremity of the clavicle and the acromion process of the scapula. It frequently has an interarticular fibro-cartilage and 2 synovial membranes; usually but 1 synovial membrane is present, and 3 ligaments, viz.—

Superior Acromio clavicular.[1]
Inferior Acromio-clavicular.
Coraco-clavicular[2] divided into— { Trapezoid, externally. Conoid, internally.

What are the proper Ligaments of the Scapula? They are 2, the coraco-acromial, and the transverse, as follows.—

FIG. 33.



Coraco-acromial,[3] completes the vault partially formed by the 2 processes over the head of the humerus.

Transverse,[4] from the base of the coracoid process to the margin of the suprascapular notch, converting it into a foramen, for the supra-scapular nerve.

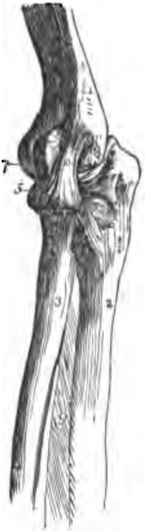
Describe the Shoulder-joint. It is an enarthrodial joint, formed by the head of the humerus and the glenoid cavity of the scapula. It has a *Synovial Membrane* which is reflected upon the tendons of the biceps, subscapularis, and infraspinatus muscles, and communicates with bursæ beneath the 2 latter tendons. Its *Arteries* are derived from the anterior and posterior circumflex and the suprascapular; its *Nerves* from the circumflex and the suprascapular. It has 3 ligaments, viz.—

Capsular,[5] from the margin of the glenoid cavity to the anatomical neck of the humerus; has 3 openings for the reflexions of the synovial membrane over the tendons.

Coraco-humeral,[6] intimately united with the capsular, extends from the coracoid process to the greater tuberosity.

Glenoid, a fibro-cartilaginous ring, continuous above with the tendon of the long head of the biceps,[7] and attached around the margin of the glenoid cavity in order to deepen the articular surface.

Fig. 34.



Describe the Elbow-joint. It is a ginglymus articulation, formed by the lower end of the humerus with the greater sigmoid cavity of the ulna and the head of the radius. Its *Synovial Membrane* is reflected over the ligaments, and dips down between the surfaces of the superior radio-ulnar articulation. Its *Arteries* are derived from the anastomotica magna, radial,ulnar, and interosseous recurrent, superior and inferior profunda arteries. Its *Nerves* are branches of the ulnar and the musculo-cutaneous. It has 4 ligaments,—

Anterior, from the inner condyle and anterior surface of the humerus to the orbicular ligament of the radius and the coronoid process of the ulna.

Posterior, from the posterior surface of the humerus to the olecranon process of the ulna.

External Lateral,[4] from the external condyle of the humerus to the orbicular ligament of the radius.

Internal Lateral, from the internal condyle of the humerus to the coronoid and olecranon processes of the ulna.

Describe the Radio-ulnar Articulations. They are 3 in number, as follows, viz.—

SUPERIOR RADIO-ULNAR ARTICULATION is a lateral ginglymoid joint, formed by the head of the radius and the lesser sigmoid cavity of the ulna. Its synovial membrane is a continuation of that in the elbow-joint. It has 1 ligament, the—

Orbicular Ligament,[5] forms four-fifths of a circle and surrounds the neck of the radius. It is attached to the margins of the lesser sigmoid cavity of the ulna, and to the external lateral ligament of the elbow-joint.

MIDDLE RADIO-ULNAR ARTICULATION is formed by the shafts of the radius and ulna, which do not touch each other, but are connected by 2 ligaments, as follows, viz.—

Oblique Ligament, from the tubercle at the base of the coronoid process of the ulna to the shaft of the radius.

Interosseous Membrane,[9] obliquely downwards from the interosseous ridge on the radius to that on the ulna. Through the interval between its upper border and the oblique ligament, the posterior interosseous vessels pass.

INFERIOR RADIO-ULNAR ARTICULATION is a lateral ginglymoid joint, formed by the head of the ulna and the sigmoid cavity of the radius. Its *Synovial Membrane* (membrana sacciformis) is very loose, and sometimes communicates with that of the wrist-joint through an opening in the *triangular fibro-cartilage* which separates the head of the ulna from the wrist-joint, and acts as one of the ligaments of this articulation, which are 3, viz.—

Anterior Radio-ulnar. *Posterior Radio-ulnar.*
Triangular Interarticular Fibro-cartilage.

Describe the Wrist-joint. It is chiefly an enarthrodial articulation, though incapable of rotation, and is formed by the lower end of the radius and the triangular fibro-cartilage, with the scaphoid, semilunar, and cuneiform bones of the carpus. Its *Arteries* are the anterior and posterior carpal from both the radial and ulnar, the anterior and posterior interosseous and ascending branches from the deep palmar arch. Its *Nerves* are derived from the ulnar; it is lined by a *synovial membrane*, and has 4 ligaments, viz.—

External Lateral (radio-carpal). *Anterior.*
Internal Lateral (ulno-carpal). *Posterior.*

Describe the Carpal Articulations. They are in 3 sets, (1) between the bones of the first row, (2) between the bones of the second row, (3) between the 2 rows of bones.

(1) The scaphoid, semilunar, and cuneiform bones are connected together by *2 Dorsal, 2 Palmar, and 2 Interosseous Ligaments.* The pisiform bone has a separate capsular ligament and synovial membrane and *2 fasciculi* connecting it with the unciform and the 5th metacarpal.

(2) The 4 bones of the second row are connected together by *3 Dorsal, 3 Palmar, and 3 Interosseous Ligaments.*

(3) The 2 rows of bones are united by *a Dorsal, a Palmar, and 2 Lateral Ligaments*, the last named being continuous with the lateral ligaments of the wrist-joint.

Describe the Carpo-metacarpal Articulations. That of the thumb with the trapezium is an enarthrodial joint, having a *Capsular Ligament* and a separate synovial membrane. The 4 inner metacarpal bones form 4 arthrodial joints with the adjacent carpal bones by *6 Dorsal, 8 Palmar, and 2 Interosseous Ligaments*, irregularly disposed.

Describe the Synovial Membranes of the Wrist. They number 5, and are situated as follows, viz.—

The First, or Membrana Sacciformis, between the head of the ulna, the sigmoid cavity of the radius, and the triangular interarticular fibro-cartilage.

The Second, between the lower end of the radius, the triangular fibro-cartilage, and the scaphoid, semilunar, and cuneiform bones of the carpus.

The Third, between all the carpal bones except the pisiform, and between the bases of the inner 4 metacarpal bones; but it extends only halfway into the 2 intervals between the 3 proximal bones of the carpus.

The Fourth, between the trapezium and the metacarpal bone of the thumb.

The Fifth, between the cuneiform and pisiform bones.

Describe the Metacarpo-metacarpal Articulations. The 4 inner metacarpal bones are connected together at their bases by *Dorsal, Palmar, and Interosseous Ligaments;* and at their digital extremities by the *Transverse Ligament.*

Describe the remaining Articulations of the Hand. The metacarpo-phalangeal and the phalangeal articulations are all ginglymoid joints, and each has an *Anterior* and *2 Lateral Ligaments,* the former being lined each with a synovial membrane. There are no posterior ligaments to these articulations, the extensor tendons of the hand supplying their places.

Describe the Hip-joint. It is a true enarthrodial articulation, formed by the head of the femur with the acetabulum of the os innominatum. Its *Synovial Membrane* is extensive, investing most of the head and neck of the femur, the capsular, cotyloid and teres ligaments, and the cavity of the acetabulum. Its *Arteries* are derived from the obturator, sciatic, internal circumflex, and gluteal. Its *Nerves* are branches from the sacral plexus, great sciatic, obturator, and accessory obturator. It has 5 ligaments, as follows, viz.—

Capsular, from the margin of the acetabulum and the transverse ligament, into the base of the neck of the femur above, the anterior inter-trochanteric line in front, and to the middle of the neck of the bone, behind.

Ilio-femoral or Y-ligament, from the anterior inferior spine of the ilium, into the anterior inter-trochanteric line by two fasciculi. It is a dissected portion of the capsular ligament which is very strong anteriorly.

Ligamentum Teres, from a depression on the head of the femur into the margins of the cotyloid notch of the acetabulum and into the transverse ligament, by two fasciculi.

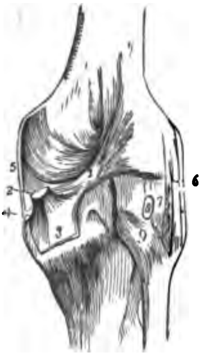
Cotyloid, a fibro-cartilaginous band surrounding the margin of the acetabulum in order to deepen its cavity.

Transverse, that part of the cotyloid ligament which crosses over the cotyloid notch converting it into a foramen.

Describe the Knee-joint. It is a ginglymus articulation, formed by the condyles of the femur with the head of the tibia, and the patella in front. Its *Synovial Membrane* is the largest in the body, being reflected for 2 or 3 inches over the anterior surface of the femur, where it is supported by the subcrureus muscle, also over its condyles, the patella, semilunar cartilages, crucial ligaments, and head of the tibia; and is prolonged through an opening in the capsular ligament beneath the tendon of the popliteus. Its *Arteries* are derived from the anastomotica magna, the 5 articular branches of the popliteal, and the recurrent branch of the anterior tibial. Its *Nerves* are branches of the obturator, anterior crural, external and internal popliteal. It has 14 ligaments, of which 6 are external and 8 internal, as follows:—

Anterior, or Ligamentum Patellæ, is a continuation of the tendon of the rectus femoris muscle, extending from the apex of the patella to the lower part of the tubercle of the tibia.

FIG. 35.



Posterior, or Ligamentum Winslowii,[1] from the inner tuberosity of the tibia to the external condyle of the femur, being partly derived from the tendon of the semimembranosus muscle.[8]

Internal Lateral,[5] from the internal condyle of the femur to the internal surface of the tibia and semilunar cartilage.

2 External Lateral,[6] from the external condyle of the femur to the head of the fibula. These ligaments are *a Long* anteriorly and *a Short* posteriorly, separated by the tendon of the biceps.

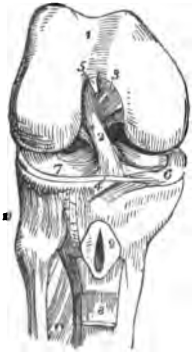
Capsular, is only present where intervals are left by the preceding ligaments. It is thin but very strong.

The Internal ligaments are as follows:—

Anterior Crucial,[2] from the depression in front of the spine of the tibia to the inner side of the *outer condyle* of the femur.

Posterior Crucial,[3] from the same depression, to the outer side of the *inner condyle.* [To remember the positions and insertions of these crucial ligaments, let the student cross his index fingers over each knee in succession; when over the right knee placing the right finger in front, when over the left knee the left finger in front. The positions of the fingers will then in each case correspond with those of the respective crucial ligaments.]

FIG. 36.



2 Semilunar Fibro-cartilages,[6] external and internal, are situated between the articular surfaces, and attached to the depressions in front and behind the spine of the tibia.

Transverse,[4] is a connecting slip between the semilunar fibro-cartilages anteriorly.

Coronary,[7] are short bands connecting the outer margins of the fibro-cartilages to the tibia and the adjacent ligaments.

Ligamentum Mucosum, is a triangular fold of the synovial membrane which at the lower border of the patella is given off to the intercondyloid notch of the femur.

Ligamenta Alaria, are fringes on the sides of the ligamentum mucosum, and are attached to the sides of the patella.

Bursæ in the vicinity of this joint are 5, viz.—1 under the ligamentum patellæ,[9] 1 between the patella and the skin; 1 between the internal lateral ligament and the tendons crossing it; sometimes 1 replacing the synovial pouch on the anterior surface of the femur; and occasionally 1 in the popliteal space replacing the synovial pouch usually situated therein.

Describe the Tibio-fibular Articulations. They are 3 in number, as follows, viz.—

SUPERIOR TIBIO-FIBULAR ARTICULATION, is an arthrodial joint, formed by the contiguous surfaces of the bones. It has a *Synovial Membrane* which is sometimes continuous with that of the knee-joint, and 2 ligaments, the—

Anterior and Posterior Superior Tibio-fibular,[10] which connect the head of the fibula with the outer tuberosity of the tibia.

MIDDLE TIBIO-FIBULAR ARTICULATION. The shafts of these bones do not touch each other, but are connected by the *Interosseous Membrane* extending between their contiguous borders, and perforated, above for the anterior tibial artery, below for the anterior peroneal vessels.

INFERIOR TIBIO-FIBULAR ARTICULATION, is an amphi-arthrodial joint, formed by the contiguous rough surfaces on the bones. Its *Synovial Membrane* is derived from that of the ankle-joint, and it has 4 ligaments, viz.—

Inferior Interosseous, continuous with the interosseous membrane.

Anterior and Posterior Inferior Tibio-fibular, from the margins of the external malleolus to the front and back of the tibia.

Transverse, posteriorly between the 2 malleoli.

Describe the Ankle-joint. It is a ginglymoid articulation, formed by the lower ends of the tibia and fibula and their malleoli, with the astragalus. Its *Synovial Membrane* is prolonged upwards between the tibia and fibula for a short distance. Its *arteries* are derived from the malleolar branches of the anterior tibial and peroneal arteries; and its *Nerves* from the anterior tibial nerve. It has 3 ligaments, viz.—

Anterior, connecting the margins of the tibia and astragalus.

Internal Lateral, or Deltoid Ligament, from the internal malleolus to the 3 adjacent tarsal bones.

External Lateral, by anterior posterior and middle fasciculi, from the external malleolus to the astragalus and os calcis.

Describe the Tarsal Articulations. They are in 3 sets, (1) between the bones of the first row, (2) between the bones of the second row, (3) between the 2 rows of bones.

(1.) The astragalus and os calcis are united by 3 ligaments.

External Calcaneo-astragaloid. *Interosseous.*
Posterior Calcaneo-astragaloid.

(2.) The scaphoid, cuboid, and three cuneiform bones are united by an irregular number of *Dorsal* and *Plantar* and 4 *Interosseus* ligaments, which latter are arranged transversely.

(3.) The 2 rows of bones are united by 7 ligaments viz.—

Superior Astragalo-scaphoid.
Superior Calcaneo-cuboid.
Superior Calcaneo-scaphoid.
Inferior Calcaneo-scaphoid.
Short Calcaneo-cuboid.
Long Calcaneo-cuboid.
Interosseous, or Internal Calcaneo-cuboid.

Describe the Tarso-metatarsal Articulations. They are 5 arthrodial joints formed by the bases of the metatarsal bones with the adjacent bones of the tarsus, the 2d metatarsal bone articulating with all 3 cuneiform in the recess formed by the shortness of the second cuneiform. They are united by *Dorsal, Plantar, and* 3 *Interosseous Ligaments.* The 2d metatarsal bone has 3 dorsal ligaments, 1 from each cuneiform bone. The interosseous ligaments pass from the 2d and 3d metatarsal bones to the internal and external cuneiform.

Describe the Synovial Membranes of the Tarsus and Metatarsus. They are 6 in number, and are situated as follows, viz.—

The First, between the os calcis and the astragalus, behind the interosseous ligament.

The Second, between the same bones in front of the interosseous ligament, also between the astragalus and the scaphoid.

The Third, between the os calcis and the cuboid.

The Fourth, between the scaphoid and the 3 cuneiform bones, running backwards between the scaphoid and the cuboid, forwards between the cuneiform bones, between the external cuneiform and the cuboid, between the middle and external cuneiform and the bases of the 2d and 3d metatarsal, passing also between the bases of these bones and the 4th metatarsal.

The Fifth, between the cuboid and the 4th and 5th metatarsal bones, also running forwards between their bases.

The Sixth, between the internal cuneiform and the base of the 1st metatarsal bone.

Describe the Metatarso-metatarsal Articulations. The metatarsal bones are connected together, except the first, at their bases by *Dorsal, Plantar, and Interosseous Ligaments;* and all 5 are connected at their digital extremities by the *Transverse Metatarsal Ligament.*

Describe the remaining Articulations of the Foot. The metatarso-phalangeal and the phalangeal articulations are similar to those in the hand, each having an *Interior or Plantar*, and 2 *Lateral Ligaments.* The extensor tendons of the foot supply the places of posterior ligaments.

THE MUSCLES AND FASCIÆ.

What are the Muscles? They are the active organs of locomotion, formed of bundles of reddish fibres endowed with the property of shortening themselves upon irritation, which is called *muscular contractility*, and chemically consisting of syntonin, or muscular fibrin.

How are the Muscles divided? Into 2 great classes, (1) *Voluntary, Striped, or Muscles of animal life*, comprise those which are under the control of the will. (2) *Involuntary, Unstriped, or Muscles of organic life*, are those which are not under the control of the will.

Voluntary Muscular Fibre consists of fasciculi about $\frac{1}{400}$ inch in diameter, each surrounded by a tubular membranous sheath, the perimysium; and marked by fine striæ passing around them in curved parallel lines about $\frac{1}{11000}$ inch apart. These fasciculi are formed of *fibrillæ*, each about $\frac{1}{18000}$ inch thick, also striated, presenting the appearance of a row of minute particles, the "sarcous elements" of Bowman, and surrounded by cellular tissue, the sarcolemma.

Involuntary Muscular Fibre consists of flattened fusiform or spindle-shaped fibres, averaging about $\frac{1}{4000}$ inch in breadth, consisting of elongated cells, and bound together in bundles by areolar tissue. These fibres are found in the alimentary canal, in the posterior wall of the trachea, in the bronchi, the ducts of certain glands, in the ureters, bladder, urethra, genitalia of both sexes, walls of all arteries and most veins and lymphatics, in the iris and ciliary muscle, and in the skin.

What are Tendons and Aponeuroses? *Tendons* are white, glistening cords or bands formed of white fibrous tissue almost entirely, have few vessels and no nerves, and serve to connect the muscles with the structures on which they act. *Aponeuroses* are fibrous membranes, of similar structure and appearance, and serve the same purpose.

What are Fasciæ? They are laminæ of variable thickness which invest (*fascia*, a bandage) the softer structures. The superficial fascia is composed of fibro-areolar tissue, and is found beneath the skin almost over the whole body. The deep fascia is of aponeurotic structure, dense, inelastic, and fibrous, ensheathing the muscles and affording some of them attachment, also the vessels and nerves, and binding down the whole into a shapely mass.

To what Structures are Muscles attached? To the periosteum and perichondrium of bone and cartilage, to the subcutaneous areolar tissue, and to ligaments. In the latter case only are their tendons in direct contact with the tissue on which they are to act.

How many Muscles are Double-bellied? Five,—the occipito-frontalis, biventer cervicis, digastric, omo-hyoid, and the diaphragm.

Describe each Muscle of the Body, giving its Origin, Insertion, Action, and Nervous supply.

MUSCLES OF THE HEAD.

Occipito-frontalis,[a] *from* the external two-thirds of the superior curved line of the occipital bone and the mastoid process of the temporal; also from the pyramidalis nasi, corrugator supercilii, and orbicularis palpebrarum fibres,—*into* an aponeurosis or "galea capitis," which covers the vertex of the skull. *Action*, chiefly as a muscle of facial expression. *Nerves*, facial, supraorbital, small occipital.

Attollens Aurem, *from* the occipito-frontalis aponeurosis,—*into* the pinna of the ear superiorly. *Action*, to raise the pinna. *Nerve*, small occipital branch of the cervical plexus.

Attrahens Aurem, *from* the lateral cranial aponeurosis,—*into* the helix of the ear anteriorly. *Action*, to draw the pinna forwards. *Nerves*, facial, and auriculo-temporal branch of the inferior maxillary.

Retrahens Aurem, *from* the mastoid process of the temporal bone,—*into* the concha. *Action*, to retract the pinna. *Nerve*, facial.

Orbicularis Palpebrarum, *from* the internal angular process of the frontal bone, the nasal process of the superior maxillary, and the borders of the tendo oculi,—*into* the skin of the eyelids, forehead, temple, and cheek, blending with the occipito-frontalis and the corrugator supercilii. *Action*, to close the eyelids. *Nerve*, facial.

Corrugator Supercilii, *from* the inner end of the superciliary ridge of the frontal bone,—*into* the orbicularis palpebrarum. *Action*, to draw eyebrow downwards and inwards. *Nerve*, facial.

Tensor Tarsi (Horner's muscle), *from* the crest of the lachrymal bone,—*into* the tarsal cartilages by two slips. *Action*, to compress the puncta lachrymalia against the globe of the eye, and to compress the lachrymal sac. *Nerve*, facial.

Levator Palpebræ Superioris, *from* the lesser wing of the sphenoid,—*into* the upper tarsal cartilage. *Action*, to lift the upper lid. *Nerve*, 3d cranial, or motor oculi.

Rectus Superior, *from* the upper margin of the optic foramen and the sheath of the optic nerve,—*into* the sclerotic coat. *Action*, to rotate the eyeball upwards. *Nerve*, 3d cranial.

Rectus Inferior, *from* the ligament of Zinn,—*into* the sclerotic coat. *Action*, rotates the eyeball downwards. *Nerve*, 3d cranial.

Rectus Internus, *from* the ligament of Zinn,—*into* the sclerotic coat. *Action*, rotates the eyeball inwards. *Nerve*, 3d cranial.

Rectus Externus, by 2 heads, the upper from the outer margin of the optic foramen, the lower from the ligament of Zinn and a bony process at lower margin of the sphenoidal fissure,—*into* the sclerotic coat. *Action,* to rotate the eyeball outwards. *Nerve,* 6th cranial, or abducens.

Between the 2 heads of the external rectus pass the 3d, nasal branch of the 5th, and the 6th cranial nerves, and the ophthalmic vein.

Obliquus Superior, *from* about a line above the inner margin of the optic foramen, its tendon passing through a "pulley" near the internal angular process of the frontal bone and thence beneath the rectus superior,—*into* the sclerotic coat at right angles to the insertion of the rectus superior. *Action,* to rotate the eyeball on its antero-posterior axis. *Nerve,* 4th cranial, or patheticus.

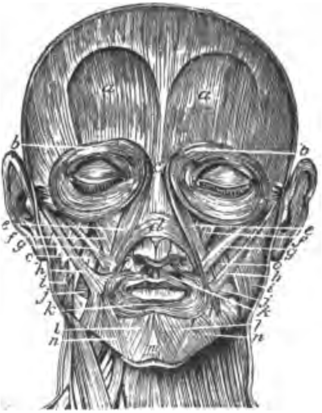
Obliquus Inferior, *from* the orbital plate of the superior maxillary,—*into* the sclerotic coat below the insertion of the external rectus and at right angles thereto. *Action,* to rotate the eye on its antero-posterior axis. *Nerve,* 3d cranial.

Pyramidalis Nasi,[c] *from* the occipito-frontalis,—*into* the compressor naris. *Action,* to depress the eyebrow. *Nerve,* facial.

Levator Labii Superioris Alæque Nasi,[e] *from* the nasal process of the superior maxillary bone,—*into* the cartilage of the ala of the nose and into the upper lip. *Action,* to elevate the upper lip, and dilate the nostril. *Nerve,* facial.

Dilator Naris Anterior, *from* the cartilage of the ala,—*into* the border of its integument. *Action,* to dilate the nostril. *Nerve,* facial.

FIG. 37.



Dilator Naris Posterior, *from* the nasal notch of the superior maxillary and the sesamoid cartilages,—*into* the integument at the margin of the nostril. *Action,* to dilate the nostril. *Nerve,* facial.

Compressor Naris,[d] *from* the superior maxillary above the incisive fossa,—*into* the fibro-cartilage of the nose, being continuous with its fellow and the pyramidalis nasi aponeurosis. *Action,* to dilate the nostril. *Nerve,* facial.

Compressor Narium Minor, *from* the alar cartilage,—*into* the skin at the end of the nose. *Action,* to dilate the nostril. *Nerve,* facial.

Depressor Alæ Nasi, *from* the incisive fossa of the superior maxillary,—*into* the septum and ala of the nose. *Action,* to contract the nostril. *Nerve,* facial.

Levator Labii Superioris,[f] *from* the lower margin of the orbit,—*into* the upper lip. *Action,* to elevate the lip. *Nerve,* facial.

Levator Anguli Oris,[o] *from* the canine fossa of the superior maxillary,—*into* the angle of the mouth. *Action,* as named. *Nerve,* facial.

Zygomaticus Major,[h] *from* the malar bone,—*into* the angle of the mouth. *Action,* to raise the lip outwards. *Nerve,* facial.

Zygomaticus Minor,[g] *from* the malar bone anteriorly,—*into* the angle of the mouth, blending with the levator labii superioris. *Action,* to raise the lip outwards. *Nerve,* facial.

Levator Labii Inferioris[m] (Levator Menti), *from* the incisive fossa of the inferior maxillary bone,—*into* the integument of the lower lip. *Action,* as named. *Nerve,* facial.

Depressor Labii Inferioris[l] (Quadratus Menti), *from* the external oblique line of the inferior maxillary bone,—*into* the lower lip. *Action,* as named. *Nerve,* facial.

Depressor Anguli Oris[n] (Triangularis Menti), *from* the external oblique line of the inferior maxillary,—*into* the angle of the mouth. *Action,* as named. *Nerve,* facial.

Orbicularis Oris,[k] by accessory fibres (accessorii orbicularis superioris and inferioris, and naso-labialis) *from* the nasal septum and the superior and inferior maxillary borders,—*into* the buccinator and other adjacent muscles, forming the sphincter of the mouth. *Action,* to close the mouth. *Nerve,* facial.

Buccinator,[j] *from* the posterior alveolar processes of both the maxillary bones and the pterygo-maxillary ligament,—*into* the orbicularis oris. *Action,* to compress the cheeks. *Nerves,* facial, and the buccal branch of the inferior maxillary.

Risorius, *from* the fascia over the masseter muscle,—*into* the angle of the mouth. *Action,* the laughing muscle. *Nerve,* facial.

Masseter,[i] *from* the anterior two-thirds and the inner surface of the zygoma and the malar process of the superior maxillary,—*into* the angle, ramus, and coronoid process of the lower jaw. *Action,* to raise the back part of the lower jaw; a muscle of mastication. *Nerve,* inferior maxillary.

Temporal, *from* the temporal fossa and temporal fascia,—*into* the coronoid process of the inferior maxillary. *Action,* to bring the incisor teeth together; the biting muscle. *Nerve,* inferior maxillary.

Internal Pterygoid, *from* the pterygoid fossa of the sphenoid bone, and the tuberosity of the palate,—*into* the angle and inner surface of the ramus of the jaw, as high as the dental foramen. *Action*, raises and draws forward the lower jaw; a triturating muscle of mastication. *Nerve*, inferior maxillary.

External Pterygoid, by 2 heads, *the upper*, from the pterygoid ridge on the greater wing of the sphenoid, *the lower* from the external pterygoid plate, and the tuberosities of the palate and superior maxillary bones,—*into* a depression in front of the condyle of the inferior maxillary, and the inter-articular fibro-cartilage. *Action*, to draw the jaw forwards; a triturating muscle of mastication. *Nerve*, inferior maxillary.

Between the two heads of the external pterygoid muscle passes the internal maxillary artery.

MUSCLES OF THE EAR.

Tensor Tympani, *from* the under surface of the petrous portion of the temporal bone, the cartilaginous Eustachian tube, and its own osseous canal,—*into* the handle of the malleus. *Action*, to draw the membrana tympani tense. *Nerve*, branch from otic ganglion.

Laxator Tympani Major, *from* the spinous process of the sphenoid and the cartilaginous Eustachian tube,—through the Glasserian fissure to the neck of the malleus just above the processus gracilis. *Action*, to relax the membrana tympani. *Nerve*, tympanic branch of the facial.

Laxator Tympani Minor, *from* the back of the external meatus,—passes between the layers of the membrana tympani *into* the handle of the malleus and processus brevis. *Action*, to relax the membrana tympani. Considered a ligament by many anatomists (the lig. mallei posticum).

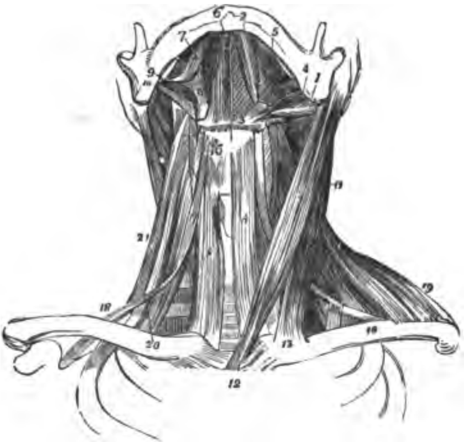
Stapedius, *from* the interior of the pyramid,—through the orifice at its apex *into* the neck of the stapes. *Action*, to depress the base of the stapes. *Nerve*, filament from the facial.

MUSCLES OF THE NECK.

Platysma Myoides, *from* the clavicle, the acromion, and the fascia covering the pectoral, deltoid, and trapezius muscles,—*into* the lower jaw, the angle of the mouth, and the cellular tissue of the face. *Action*, to wrinkle the skin, and depress the mouth. *Nerves*, facial and superficial cervical.

Sterno-cleido-mastoid,[11] by two heads from the sternum[12] and the clavicle[13] at its inner third,—*into* the mastoid process of the temporal bone, and the superior curved line of the occipital. *Action*, to depress and rotate the head. *Nerves*, spinal accessory, and branches of the cervical plexus.

FIG. 38.



Between the sternal and clavicular origins is a fossa, the *fonticulus gutturis*, which rises and falls during labored breathing.

Sterno-hyoid,[14] *from* the posterior surface of the sternum and the sternal end of the clavicle, — *into* the body of the hyoid bone. *Action*, to depress the hyoid bone. *Nerve*, a branch from the communicating loop between the descendens and communicans noni.

Sterno-thyroid,[15] *from* the posterior surface of the sternum and the cartilage of the 1st rib,—*into* the oblique line on the ala of the thyroid cartilage. *Action*, to depress the larynx. *Nerve*, a branch from the communicating loop between the descendens and communicans noni.

Thyro-hyoid,[16] *from* the oblique line on the thyroid cartilage,—*into* the body and greater cornu of the hyoid bone. *Action*, to elevate the larynx. *Nerve*, hypoglossal.

Omo-hyoid,[17] [18] *from* the upper border of the scapula and the transverse ligament,—*into* the body of the hyoid bone. It has a tendon in its centre which is bound down to the cartilage of the 1st rib by a loop of the deep cervical fascia. *Action*, to depress the hyoid bone, and draw it backwards. *Nerve*, branch from the communicating loop between the descendens and communicans noni.

Digastric, by 2 bellies, the *posterior one*[1] from the digastric groove of the mastoid process of the temporal bone; the *anterior*[2] from a fossa on the inner surface of the inferior maxillary, near its symphysis,—*into* a central tendon[3] which perforates the stylo-hyoid muscle, and is bound down to the body of the hyoid bone by an aponeurotic loop. *Action*, to raise the hyoid bone and tongue. *Nerves*, facial, and mylo-hyoid branch of the inferior dental.

Stylo-hyoid,[4] *from* the styloid process of the temporal bone near its base,—*into* the body of the hyoid bone. *Action*, to elevate and retract the hyoid bone. *Nerve*, facial. This muscle is perforated by the digastric.

Mylo-hyoid,[5] *from* the mylo-hyoid ridge of the lower jaw,—*into* the body of the hyoid bone and a fibrous raphé in the median line running from the hyoid bone to the chin. *Action,* elevates the hyoid bone and draws it forwards, also forms the floor of the mouth. *Nerve,* mylo-hyoid branch of inferior dental.

Genio-hyoid,[6] *from* the inferior genial tubercle of the inferior maxillary,—*into* the body of the hyoid bone. *Action,* same as the mylo-hyoid. *Nerve,* hypoglossal.

Genio-hyo-glossus, *from* the superior genial tubercle of the inferior maxillary,—*into* the body of the hyoid bone, the side of the pharynx, and the whole length of the under surface of the tongue, forming a fan-like muscle. *Action,* to retract and protrude the tongue. *Nerve,* hypoglossal.

Hyo-glossus[8] (the basio-kerato-chondro-glossus), *from* the body of the hyoid bone, its lesser cornu, and the whole length of its greater cornu,—*into* the side of the tongue. *Action,* to draw down the side of the tongue. *Nerve,* hypoglossal.

Stylo-glossus,[9] *from* the styloid process and the stylo-maxillary ligament,—*into* the side of the tongue and the hyo-glossus muscle. *Action,* to elevate and retract the tongue. *Nerve,* hypoglossal.

Lingualis, lies between the hyo-glossus and the genio-hyo-glossus, from the base to the tip of the tongue, along its under surface; some of its fibres being attached to the hyoid bone. *Action,* to elevate the centre of the tongue. *Nerve,* chorda tympani.

Inferior Constrictor, *from* the sides of the cricoid and thyroid cartilages,—*into* the fibrous raphé of the pharynx. *Action,* to contract the pharyngeal calibre. *Nerves,* glosso-pharyngeal, pharyngeal plexus, and external laryngeal.

Middle Constrictor, *from* the cornua of the hyoid bone and the stylo-hyoid ligament,—*into* the pharyngeal raphé. *Action,* to constrict the pharynx. *Nerves,* glosso-pharyngeal, pharyngeal plexus.

Superior Constrictor, *from* the lower third of the margin of the internal pterygoid plate and its hamular process, the contiguous part of the palate bone, the tendon of the tensor palati, the pterygo-maxillary ligament, part of the alveolar process of the lower jaw and the side of the tongue,—*into* the pharyngeal raphé and the pharyngeal spine of the occipital bone. *Action,* to constrict the pharynx. *Nerves,* glosso-pharyngeal, pharyngeal plexus.

Stylo-pharyngeus,[10] *from* the inner side of the base of the styloid process,—*into* the constrictor and palato-pharyngeus muscles, and the thyroid cartilage. *Action*, to elevate the pharynx. *Nerves*, glosso-pharyngeal, pharyngeal plexus. The former nerve crosses this muscle in passing to the tongue.

Levator Palati, *from* the under surface of the apex of the petrous portion of the temporal bone and from the Eustachian tube,—*into* the posterior surface of the soft palate. *Action*, to elevate the soft palate. *Nerve*, facial, through the Vidian and petrosal.

Tensor Palati, *from* the scaphoid fossa of the sphenoid bone and the Eustachian tube,—reflected around the hamular process,—*into* the anterior surface of the soft palate, and the horizontal portion of the palate bone. *Action*, to tense the palate. *Nerve*, a branch from the otic ganglion.

Azygos Uvulæ, *from* the posterior nasal spine of the palate bone, and from the soft palate,—*into* the uvula. *Action*, possibly to raise the uvula. *Nerve*, facial, through the Vidian and petrosal. This muscle is wrongly named, as it is double.

Palato-glossus (anterior pillar of the fauces), *from* the anterior surface of the soft palate laterally,—*into* the side and dorsum of the tongue. *Action*, constrictor isthmi faucium. *Nerves*, palatine branches of Meckel's ganglion.

Palato-pharyngeus (posterior pillar of the fauces), *from* the soft palate,—*into* the side of the pharynx and the posterior border of the thyroid cartilage, having joined the stylo-pharyngeus. *Action*, to close the posterior nares. *Nerves*, palatine branches from Meckel's ganglion.

Rectus Capitis Anti′cus Major, *from* the anterior tubercles of the transverse processes of the 3d, 4th, 5th, and 6th cervical vertebræ by 4 slips,—*into* the basilar process of the occipital bone. *Action*, to flex the head. *Nerves*, sub-occipital and deep branches of cervical plexus. This muscle is a continuation of the scalenus anticus.

Rectus Capitis Anti′cus Minor, *from* the anterior surface of the lateral mass of the atlas, and the root of its transverse process,—*into* the basilar process of the occipital bone. *Action*, to flex the head. *Nerves*, sub-occipital and deep branches of the cervical plexus.

Rectus Lateralis, *from* the upper surface of the transverse process of the atlas, —*into* the jugular process of the occipital bone. *Action*, to draw the head laterally. *Nerve*, sub-occipital.

Longus Colli, 3 portions,—*the superior oblique*, from the anterior tubercles of the transverse processes of the 3d, 4th, and 5th cervical vertebræ, into a tubercle on the anterior arch of the atlas:—*inferior oblique*, from the bodies of the first 2 or 3 dorsal vertebræ, into the transverse processes of the 5th and 6th cervical:—*vertical portion* from the bodies of the lower 3 cervical and upper 3 dorsal vertebræ, to the bodies of the 2d, 3d, and 4th cervical.

Action, to flex the cervical vertebræ and slightly to rotate them. *Nerves*, branches from the lower cervical.

Scalenus Anti′cus,[20] *from* a tubercle on the upper surface of the 1st rib,—*into* the transverse processes of the cervical vertebræ, from the 3d to the 6th inclusive. *Action*, to flex the neck laterally, or to raise the 1st rib. *Nerves*, branches from the lower cervical. (See Fig. 38.)

Scalenus Medius,[22] *from* the upper surface of the 1st rib, behind the subclavian groove,—*into* the transverse processes of the lower 6 cervical vertebræ. *Action*, same as scalenus anticus. *Nerves*, branches from the lower cervical.

Scalenus Posti′cus,[21] *from* the outer surface of the 2d rib,—*into* the posterior tubercles on the transverse processes of the lower 2 or 3 cervical vertebræ. *Action*, to flex the neck laterally, or to elevate the 2d rib. *Nerves*, branches from lower cervical.

MUSCLES OF THE LARYNX AND EPIGLOTTIS.

Crico-thyroid, *from* the front and side of the cricoid cartilage,—*into* the lower and inner borders of the thyroid cartilage. *Action*, to elongate and make tense the vocal chords. *Nerve*, superior laryngeal.

Crico-arytenoideus Posticus, *from* the cricoid cartilage posteriorly,—*into* the outer angle of the base of the arytenoid cartilage. *Action*, to rotate the arytenoid cartilages outwards and open the glottis, while keeping the vocal chords tense. *Nerve*, recurrent laryngeal.

Crico-arytenoideus Lateralis, *from* the upper border of the cricoid cartilage laterally,—*into* the outer angle of the base of the arytenoid cartilage. *Action*, to rotate the arytenoid cartilages inwards and close the glottis. *Nerve*, recurrent laryngeal.

Thyro-arytenoideus, *from* the receding angle of the thyroid cartilage and the crico-thyroid membrane,—*into* the base and anterior surface of the arytenoid cartilage. *Action*, to shorten and relax the vocal chords by approximating the cartilages. *Nerve*, recurrent laryngeal.

Arytenoideus, *from* the posterior surface and outer border of one arytenoid cartilage,—*into* the corresponding parts of the opposite cartilage, filling up the posterior concave surface of these cartilages. *Action*, by approximating the arytenoids, to close the back part of the glottis. *Nerves*, superior and recurrent laryngeal.

Thyro-epiglottideus, *from* the inner surface of the thyroid cartilage,—*into* the margin of the epiglottis and the aryteno-epiglottidean fold. *Action*, a depressor of the epiglottis. *Nerve*, recurrent laryngeal.

Aryteno-epiglottideus Superior, *from* the apex of the arytenoid cartilage,—*into* the aryteno-epiglottidean folds. *Action,* to constrict the superior laryngeal aperture. *Nerve,* recurrent laryngeal.

Aryteno-epiglottideus Inferior, *from* the arytenoid cartilage anteriorly,—*into* the sacculus laryngis and the margin of the epiglottis. *Action,* to compress the sacculus laryngis: *Nerve,* recurrent laryngeal.

MUSCLES OF THE BACK.

First layer (2)—*Trapezius. Latissimus Dorsi.*

Second layer (3)—*Levator Anguli Scapulæ. Rhomboideus Major and Minor.*

Third layer (3)—*Serratus Posti'cus Superior. Serratus Posti'cus Inferior.*
Splenius Capitis et Colli.

Fourth layer (11)—in 4 sets, viz.—

LUMBAR (1)—*Erector Spinæ.*

EXTERNAL (3).	MIDDLE (3).	INTERNAL (4).
Sacro-lumbalis.	*Longissimus Dorsi.*	*Spinalis Dorsi.*
Musculus Accessorius ad Sacro-lumbalem.	*Transversalis Colli.*	*Spinalis Colli.*
	Trachelo-mastoid.	*Biventer Cervicis.*
Cervicalis Ascendens.		*Complexus.*

Fifth layer (12)—6 having the word *spinal* in them, viz.—

Semi-spinalis Dorsi.
Semi-spinalis Colli.
Multifidus Spinæ.
Rotatores Spinæ.
Supra-spinales.
Inter-spinales.
Inter-transversales.
Rectus Capitis Posti'cus Major.
Rectus Capitis Posti'cus Minor.
Obliquus Capitis Superior.
Obliquus Capitis Inferior.
Extensor Coccygis.

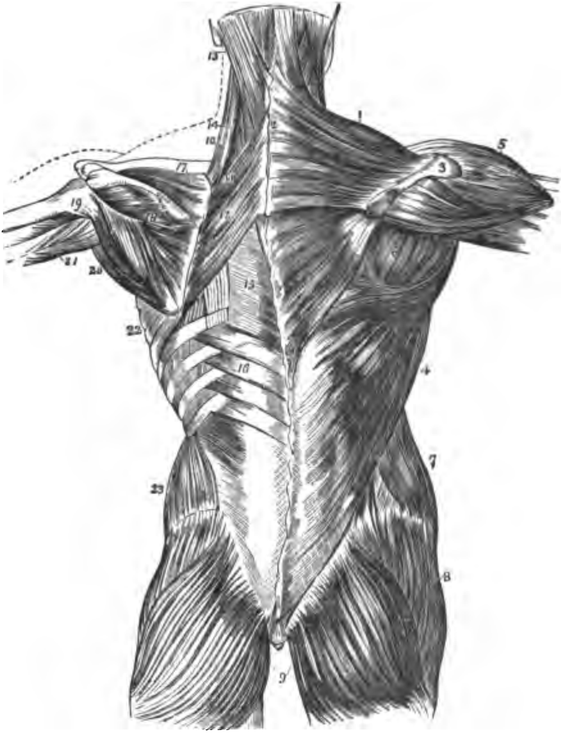
Trapezius,[1] *from* the inner third of the superior curved line of the occipital bone, the ligamentum nuchæ,[2] the spinous processes of the last cervical and all the dorsal vertebræ, and the supra-spinous ligament,—*into* the outer third of the posterior border of the clavicle, the superior margin of the acromion process, the whole length of the superior border of the spine of the scapula,[3] and a tubercle at its inner extremity. *Action,* to draw the head backwards. *Nerves,* spinal accessory, cervical plexus.

LIGAMENTUM NUCHÆ, *from* the external occipital protuberance,—*to* the spines of the cervical vertebræ, from the 2d to the 7th inclusive.

Latissimus Dorsi,[4] by an aponeurosis *from* the spines of the 6 lower dorsal and the lumbar and sacral vertebræ, the supra-spinous ligament, the crest of the ilium, and the 3 or 4 lower ribs,—*into* the bicipital groove of the humerus. *Action,* the *cursor ani* muscle, drawing the arm downwards and backwards; or raising the lower ribs and drawing the trunk forwards. *Nerves,* the subscapular.

Levator Anguli Scapulæ,[10] by 4 slips from the transverse processes of 3 or 4 upper cervical vertebræ,—*into* the posterior border of the scapula. *Action*, as named. *Nerves*, branches from the 5th cervical and the cervical plexus.

FIG. 39.



Rhomboideus Minor,[11] *from* the ligamentum nuchæ and spines of the 7th cervical and 1st dorsal vertebræ,—*into* the smooth surface at the root of the spine of the scapula. *Action*, to draw the scapula backwards and upwards. *Nerve*, 5th cervical.

Rhomboideus Major,[12] *from* the spines of the 4 or 5 upper dorsal vertebræ and the supra-spinous ligament,—*into* the scapula at the root of its spine and inferior angle, by a tendinous arch. *Action*, to draw the scapula upwards and backwards. *Nerve*, 5th cervical.

Serratus Posti′cus Superior, *from* the ligamentum nuchæ, and spines of the 7th cervical and 2 or 3 upper dorsal vertebræ,—*into* the upper borders of the 2d, 3d, 4th, and 5th ribs, by 4 digitations. *Action,* to raise ribs in inspiration. *Nerves,* external posterior branches of the cervical nerves.

Serratus Posti′cus Inferior,[16] *from* the spines of the last 2 dorsal and first 3 lumbar vertebræ,—*into* the lower borders of the 4 lower ribs, by 4 digitations. *Action,* to depress these ribs in expiration. *Nerves,* external branches of the dorsal nerves.

Splenius Capitis[13] **et Colli,**[14] *from* the lower half of the ligamentum nuchæ, the last cervical and 6 upper dorsal spines, and the supra-spinous ligament, —the *S. capitis* into the mastoid process and a rough surface below the superior curved line of the occipital bone,—the *S. colli* into the transverse processes of the 3 or 4 upper cervical vertebræ. *Action,* to draw the head backwards and the neck erect. *Nerves,* external posterior branches of the cervical nerves.

Erector Spinæ,[1] *from* the sacro-iliac groove, and by the lumbo-sacral tendon from the sacral, lumbar and 3 lower dorsal spines, the iliac crest, and the posterior eminences of the sacrum,—*divides* into the sacro-lumbalis[2] and longissimus dorsi[3] muscles. *Action,* to erect the spine and bend the trunk backwards. *Nerves,* external posterior branches of the lumbar nerves.

Sacro-lumbalis,[2] *from* the erector spinæ,—*into* the angles of the 6 lower ribs. *Action,* as the erector spinæ. *Nerves,* branches of the dorsal.

Musculus Accessorius ad Sacro-lumbalem,[2] *from* the angles of 6 lower ribs,—*into* the angles of 6 upper ribs. *Action,* as the erector spinæ. *Nerves,* branches of the dorsal.

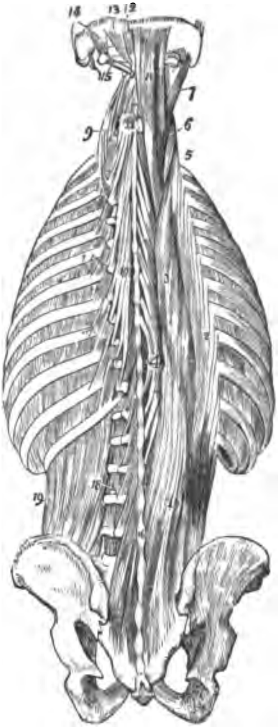
Cervicalis Ascendens,[5] *from* the angles of 4 or 5 upper ribs,—*into* the transverse processes of the 4th, 5th, and 6th cervical vertebræ. *Action,* to keep the neck erect. *Nerves,* branches of the cervical.

Longissimus Dorsi,[3] *from* the erector spinæ,—*into* the transverse and articular processes of the lumbar vertebræ, into the tips of the transverse processes of all the dorsal vertebræ, and into from 7 to 11 ribs between their tubercles and angles. *Action,* as the erector spinæ. *Nerves,* branches of the lumbar and dorsal nerves.

Transversalis Colli,[6] *from* the transverse processes of the 3d, 4th, 5th, and 6th dorsal vertebræ,—*into* the transverse processes of the 5 lower cervical. *Action,* to keep the neck erect. *Nerves,* cervical branches.

Trachelo-mastoid,[7] *from* the transverse processes of the 3d, 4th, 5th, and 6th dorsal vertebræ, and the articular processes of the 3 or 4 lower cervical,—*into* the posterior margin of the mastoid process. *Action,* to steady the head. *Nerves,* branches of the cervical.

FIG. 40.



Spinalis Dorsi, *from* the last 2 dorsal and first 2 lumbar spines,—*into* all the remaining dorsal spines. *Action,* to erect the spinal column. *Nerves,* branches of the dorsal.

Spinalis Colli, *from* the 5th and 6th cervical spines, sometimes from the 1st and 2d dorsal,—*into* the spine of the axis, or the 3d and 4th cervical spines. *Action,* to steady the neck. *Nerves,* branches of the cervical. [This muscle is frequently absent.]

Biventer Cervicis, *from* the transverse processes of 2 to 4 upper dorsal vertebræ,—*into* the superior curved line of the occipital bone. [Is but a portion of the complexus muscle.]

Complexus,[8] by 7 tendons *from* the tips of the transverse processes of the 7th cervical and 3 upper dorsal vertebræ, and from the articular processes of the 4th, 5th, and 6th cervical,—*into* the inner depression between the curved lines of the occipital bone. *Action,* to retract and rotate the head. *Nerves,* suboccipital, great occipital, and branches of the cervical nerves.

Semispinalis Dorsi,[10] *from* the transverse processes of the dorsal vertebræ, from about the 5th to the 11th,—*into* the last 2 cervical and 4 upper dorsal spines. *Action,* to erect the spinal column. *Nerves,* branches of the dorsal nerves.

Semispinalis Colli,[11] *from* the transverse processes of the 4 upper dorsal vertebræ, and the articular processes of the 4 lower cervical,—*into* the 2d, 3d, 4th, and 5th cervical spines. *Action,* to erect the spinal column. *Nerves,* branches of the cervical.

Multifidus Spinæ,[16] *from* the back of the sacrum, posterior superior spine of the ilium, posterior sacro-iliac ligaments, articular processes of lumbar and cervical vertebræ, and the transverse processes of the dorsal,—*into* the laminæ and spines of the next 4 vertebræ above. *Action,* to erect and rotate the spinal column. *Nerves,* posterior spinal branches.

Rotatores Spinæ (11), *from* the transverse processes of the dorsal vertebræ, from the 2d to the 12th inclusive,—each *into* the lamina of the next dorsal vertebræ above. *Action*, to rotate the spinal column. *Nerves*, branches of the dorsal.

Supra-spinales, lie on the spinous processes in the cervical region. *Nerves*, branches of the cervical.

Inter-spinales, placed in pairs between the spines of contiguous vertebræ, 6 pairs in the cervical region, 3 in the dorsal, 4, sometimes 6, in the lumbar. *Nerves*, posterior spinal branches.

Inter-transversales,[18] placed between the transverse processes of contiguous vertebræ, 7 in the cervical region, 12 in the dorsal, and 4 in the lumbar. *Nerves*, posterior spinal branches.

Rectus Capitis Posti′cus Major,[13] *from* the spine of the axis,—*into* the inferior curved line of the occipital bone and the surface below. *Action*, to rotate the head. *Nerves*, sub- and great occipital.

Rectus Capitis Posti′cus Minor,[12] *from* the tubercle on the posterior arch of the atlas,—*into* a rough surface between the foramen magnum and the inferior curved line of the occipital bone. *Action*, to draw the head backwards. *Nerves*, sub- and great occipital.

Obliquus Capitis Inferior,[15] *from* the spinous process of the axis,—almost horizontally to the transverse process of the atlas. *Action*, to rotate the atlas and cranium. *Nerves*, sub- and great occipital.

Obliquus Capitis Superior,[14] *from* the transverse process of the atlas;—upwards and inwards *into* the occipital bone between the curved lines. *Action*, draws the head backwards. *Nerves*, sub- and great occipital.

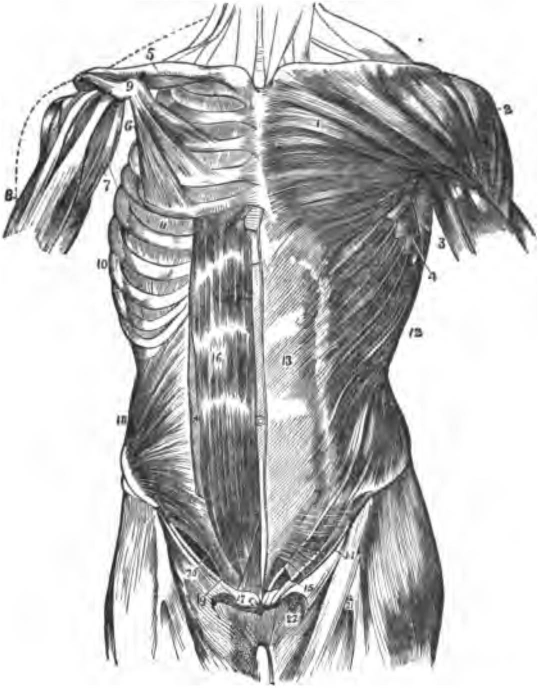
Extensor Coccygis, *from* the last bone of the sacrum or first of the coccyx,—*into* the lower part of the coccyx, posteriorly. *Action*, as named. *Nerves*, posterior sacral branches.

MUSCLES OF THE ABDOMEN.

External Oblique,[12] from 8 lower ribs by 8 fleshy digitations,—*into* the anterior half of the outer lip of the crest of the ilium, and by a broad aponeurosis,[13] into the ensiform cartilage, linea alba, symphysis, and spine of the pubes, and the pectineal line. Its aponeurosis is continuous with that of the pectoralis major above, and below it forms Poupart's[14] and Gimbernat's ligaments, and by the separation of its fibres, the external abdominal ring.[15] *Action*, to compress the viscera, and flex the thorax on the pelvis, and *vice versâ*. *Nerves*, lower intercostal, ilio-hypogastric, and ilio-inguinal.

Internal Oblique,[16] *from* the lumbar fascia, the anterior two-thirds of the middle lip of the crest of the ilium, and the outer half of Poupart's ligament,—*into* the cartilages of 4 lower ribs; by its aponeurosis into the linea alba; and leaving an arched border[20] over the spermatic cord, by the conjoined tendon[19] with the transversalis into the pubic crest and the pectineal line. Its aponeurosis splits at the rectus abdominis for its upper three-fourths, one layer passing in front, the other behind that muscle, to unite again at the linea alba; for its lower one-fourth it passes in front of the rectus. *Action and Nerves*, same as the external oblique.

FIG. 41.



Transversalis, *from* the outer one-third of Poupart's ligament, the anterior two-thirds of the inner lip of the crest of the ilium, the cartilages of 6 lower ribs, and an aponeurosis from the spines and transverse processes of the lumbar vertebræ,—by its aponeurosis into the linea alba, and by the conjoined tendon[19] with the internal oblique, into the pubic crest and the pectineal line. Its aponeurosis passes behind the rectus abdominis for its upper three-fourths, in front of that muscle for its lower one-fourth.

Lumbar Fascia, or vertebral aponeurosis of the transversalis, divides into 3 leaflets, *the anterior* and *middle* being attached to the apices of the transverse processes of the lumbar vertebræ, the *posterior* leaflet to the apices of their spines. The anterior and middle leaflets enclose the quadratus lumborum muscle, the middle and posterior enclose the erector spinæ.

Rectus Abdominis,[16] by 2 tendons from the pubic crest and the ligaments covering the symphysis,—*into* the cartilages of the 5th, 6th, and 7th ribs. It lies in a sheath formed by the aponeuroses of the internal oblique and transversalis muscles for its upper three-fourths, and is crossed by 2 to 5 tendinous lines, the *Lineæ Transversæ.* At its outer border is a similar line placed vertically, the *Linea Semilunaris*, formed by the aponeurosis of the internal oblique at its point of division. *Action*, to flex the thorax on the pelvis and *vice versâ*, also to compress the abdominal viscera. *Nerves*, same as the external oblique.

Pyramidalis,[17] lies in front of the rectus, but in the same sheath, arises *from* the front of the pubic bone and the anterior pubic ligament,—*into* the linea alba, half-way to the umbilicus. *Action*, a tensor of the linea alba. *Nerves*, same as the external oblique.

Quadratus Lumborum,[19 Fig. 40] *from* the ilio-lumbar ligament, adjacent 2 inches of the crest of the ilium, and transverse processes of the lower 3 lumbar vertebræ,—*into* one-half of the lower border of the last rib, and the transverse processes of the last 3 lumbar vertebræ. *Action*, to flex the thorax laterally on the pelvis and *vice versâ*. *Nerves*, anterior branches of the lumbar.

MUSCLES OF THE THORAX.

External Intercostals (11), each *from* the outer lip of the groove in the inferior costal border,—*into* the upper border of the next rib below, directed obliquely downwards and forwards. *Action*, to raise and evert the ribs in inspiration. *Nerves*, intercostal.

Internal Intercostals (11), each *from* the inner lip of the groove in the inferior costal border,—*into* the upper border of the rib below, directed obliquely downwards and backwards. *Action*, at sides of thorax to depress the ribs in expiration; anteriorly they raise the costal cartilages. *Nerves*, intercostals.

Infra-costales (10), obliquely *from* inner surface of 1 rib,—*into* the inner surface of the 1st, 2d, or 3d rib below. *Action*, muscles of inspiration. *Nerves*, intercostal.

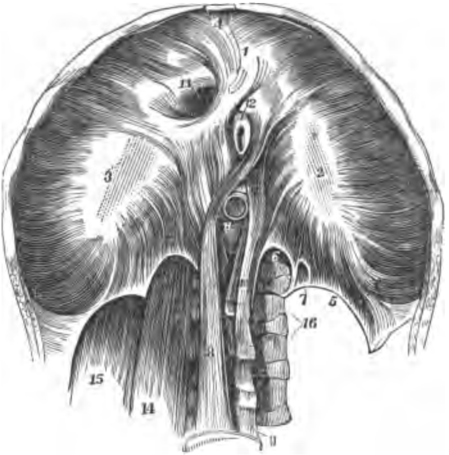
Triangularis Sterni, *from* the inner surface of the ensiform cartilage, inner surfaces of costal cartilages of 3 or 4 lower true ribs, and lower sides of the sternum,—*into* the lower border and inner surfaces of the 2d, 3d, 4th, and 5th costal cartilages. *Action*, to draw down the cartilages in expiration. *Nerves*, intercostal.

Levatores Costarum,[17] Fig. 40 (12), each *from* the transverse process of a dorsal vertebra,—*into* the upper surface of the next rib below, near its angle. *Action*, to raise the ribs. *Nerves*, intercostal.

Diaphragm, *from* the ensiform cartilage,[4] inner surfaces of 6 or 7 lower ribs, ligamenta arcuata,[5] and by its crura[8] [10] from the bodies of the lumbar vertebræ, from the 2d to the 4th on the right side, the 2d and 3d on the left,—*into* the central or cordiform tendon.[2] [3] *Action*, the great muscle of respiration and expulsion. *Nerve*, the phrenic.

Openings of the Diaphragm. The Aortic,[11] in the middle line posteriorly, and behind the diaphragm; transmits the aorta, vena azygos major, and thoracic duct, occasionally the left sympathetic nerve. *The Œsophageal*,[12] in the muscular structure, transmits the œsophagus and the pneumogastric nerves. *The Opening for the Vena Cava*[13] is the highest, and has 4 tendinous margins. *The Right Crus*[8] transmits the sympathetic and greater and lesser splanchnic nerves of that side. *The Left Crus*,[10] the greater and lesser splanchnic nerves of the left side and the vena azygos minor.

FIG. 42.



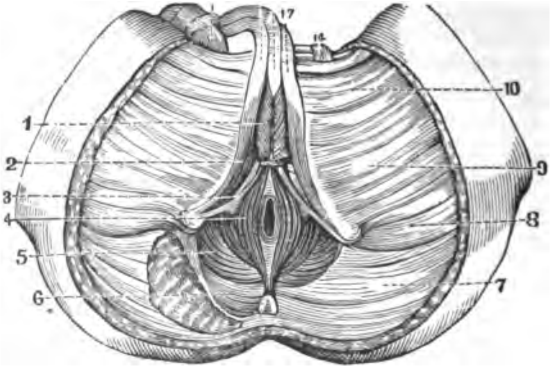
Descent of the Diaphragm. Its central tendon does not descend during inspiration, being connected with the deep cervical fascia by the fibrous pericardium.

MUSCLES OF THE PERINEUM.

Sphincter Ani,[4] *from* the tip of the coccyx and superficial fascia,—*into* the tendinous centre of the perineum. *Action*, to close the anus. *Nerve*, hemorrhoidal branch of the pudic.

Internal Sphincter, a muscular ring, half an inch broad, about an inch from the margin of the anus; is an aggregation of the involuntary circular fibres of the intestine.

FIG. 43.



Sphincter Tertius of Hyrtl, *from* the sacrum, encircling the rectum about 4 inches above the anal orifice. [Demonstrated by Hyrtl, Nelaton, and Velpeau, but denied by most anatomists.]

Accelerator Urinæ,[1] *from* the central tendon of the perineum and the median raphé in front,—fibres spread over the bulb, corpus spongiosum, corpus cavernosum,[17] and dorsal vessels. *Action,* to accelerate the flow of urine, and erect the penis. *Nerve,* perineal branch of pudic.

Erector Penis,[2] *from* the inner surface of the tuberosity of the ischium, the crus penis, and pubic ramus,—*into* the crus penis laterally and inferiorly. *Action,* to maintain erection. *Nerve,* perineal.

Transversus Perinei,[3] *from* the ascending ramus of the ischium,—*into* the central tendon of the perineum. *Action,* to draw tense the central tendon. *Nerve,* perineal.

Levator Ani,[5] *from* the body and ramus of the pubes posteriorly, pelvic fascia, and the spine of the ischium,—*into* the tendinous centre of the perineum, sides of the rectum (and vagina), apex of the coccyx, and a fibrous raphé extending from the coccyx to the anus. *Action,* to support the lower end of the rectum and vagina and the bladder, and assist in forming the floor of the pelvis. *Nerves,* inferior hemorrhoidal and 4th sacral.

Compressor Urethræ, *from* the upper part of the ramus of the pubes,—*into* its fellow of the opposite side after encircling the membranous portion of the urethra. *Action,* stop-cock muscle. *Nerve,* perineal.

Coccygeus,[6] *from* the spine of the ischium and the lesser sacro-sciatic ligament,—*into* the margin of the coccyx and the side of the last sacral segment. *Action*, to support the coccyx, and close the outlet of the pelvis posteriorly. *Nerve*, 5th sacral, anterior division.

Sphincter Vaginæ (in the female), *from* the central tendon of the perineum,—*into* the corpora cavernosa and body of the clitoris. Represents the accelerator urinæ of the male.

Erector Clitoridis (in the female), replaces the erector penis.

MUSCLES OF THE SHOULDER AND ARM.

Pectoralis Major, *from* the sternal one-half of the clavicle, by an aponeurosis from the front of the sternum as low as the 6th or 7th rib, the cartilages of all the true ribs, and the aponeurosis of the external oblique,—the fibres converge, cross and are inserted by a flat tendon *into* the external bicipital ridge of the humerus, having crossed the bicipital groove. *Action*, to draw the arm forwards and downwards; also to elevate the ribs in forced inspiration. *Nerves*, anterior thoracic.

Pectoralis Minor, *from* the 3d, 4th, and 5th ribs, and the intercostal aponeurosis,—*into* the coracoid process of the scapula. *Action*, to depress the point of the shoulder, also to elevate the ribs in forced inspiration. *Nerves*, anterior thoracic.

Subclavius, *from* the cartilage of the 1st rib,—*into* the under surface of the clavicle, in a groove about its middle 3d. *Action*, to draw the clavicle downwards. *Nerve*, a branch from the 5th and 6th cervical.

Serratus Magnus, by 9 digitations *from* the 8 upper ribs (the 2d rib having 2) and from the intercostal aponeurosis,—*into* the whole length of the inner margin of the posterior border of the scapula. *Action*, to elevate the ribs in inspiration, also to raise the point of the shoulder. In lower animals the great sling-muscle, slinging the body between the upper extremities. *Nerve*, posterior thoracic.

Deltoid, *from* the outer one-third of the anterior and superior surfaces of the clavicle, the outer margin and upper surface of the acromion, and the whole lower border of the spine of the scapula,—*into* a prominence on the outer side of the shaft of the humerus, about its middle. *Action*, to raise the arm. *Nerve*, circumflex.

Subscapularis, *from* the inner two-thirds of the subscapular fossa,—*into* the lesser tuberosity of the humerus. *Action*, to rotate the head of the humerus inwards. *Nerves*, subscapular.

Supra-spinatus, *from* the inner two-thirds of the supra-spinous fossa,—*into* the upper facet of the greater tuberosity of the humerus. *Action*, to support the shoulder-joint, and to raise the arm. *Nerve*, supra-scapular.

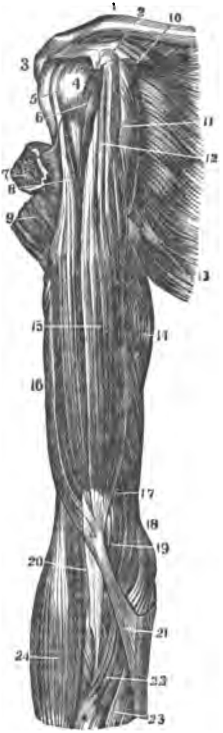
Infra-spinatus, *from* the inner two-thirds of the infra-spinous fossa,—*into* the middle facet on the greater tuberosity of the humerus. *Action,* to rotate the humerus outwards. *Nerve,* supra-scapular.

Teres Minor, *from* the upper two-thirds of the dorsal surface of the axillary border of the scapula,—*into* the lowest facet on the greater tuberosity of the humerus, and the bone below. *Action,* to rotate the humerus outwards. *Nerve,* circumflex.

Teres Major, *from* the dorsal aspect of the inferior angle of the scapula,—*into* the internal bicipital ridge of the humerus. *Action,* to assist the latissimus dorsi. *Nerve,* subscapular.

Coraco-brachialis,[11] *from* the apex of the coracoid process[2] of the scapula, —*into* a ridge on the inner side of the shaft of the humerus, about its middle. *Action,* elevates the humerus forwards and inwards. *Nerve,* musculo-cutaneous, which perforates this muscle.

FIG. 44.



Biceps[15] (Biceps Flexor Cubiti). *Long head*[1] from the upper margin of the glenoid cavity, *short head*[12] from the apex of the coracoid process,[2] in common with the coraco-brachialis,—*into* the back of the tuberosity of the radius, and the fascia of the forearm.[2] *Action,* to flex and supinate the forearm, and to make tense its fascia. *Nerve,* the musculo-cutaneous.

Brachialis Anti′cus,[17] *from* the lower half of the shaft of the humerus anteriorly and laterally, embracing the insertion of the deltoid,[2]—*into* the base of the coronoid process of the ulna.[19] *Action,* a flexor of the forearm. *Nerves,* musculo-cutaneous and musculo-spiral.

Triceps[16] (Triceps Extensor Cubiti), by three heads, *the outer and inner* from the posterior surface of the shaft of the humerus, the outer above, the inner below the musculo-spiral groove; the *middle or long head* from a depression below the glenoid cavity of the scapula, —*into* the upper end of the olecranon process of the ulna. *Action,* to extend the forearm. *Nerve,* musculo-spiral.

Subanconeus, *from* the humerus above the olecranon fossa,—*into* the posterior ligament of the elbow-joint. *Action*, probably a tensor of the ligament. *Nerve*, musculo-spiral.

MUSCLES OF THE FOREARM.

Muscles of the forearm (20), arranged in groups of five and threes. (Pancoast.)

ANTERIORLY, 5 flexors, 2 pronators, 1 tensor of palmar fascia:—

Flexor Carpi Radialis.
Flexor Carpi Ulnaris.
Flexor Longus Pollicis.
Pronator Radii Teres.
Pronator Quadratus.
Palmaris Longus.
Flexor Sublimis Digitorum Perforatus Manis.
Flexor Profundus Digitorum Perforans Manis.

POSTERIORLY (12), in 4 sets of threes:—

Supinator Longus.
Extensor Carpi Radialis Longior.
Extensor Carpi Radialis Brevior.
  Extensor Ossis Metacarpi Pollicis.
  Extensor Primi Internodii Pollicis.
  Extensor Secundi Internodii Pollicis.
Extensor Indicis.
Extensor Communis Digitorum.
Extensor Minimi Digiti.
  Extensor Carpi Ulnaris.
  Anconeus.
  Supinator Brevis.

Pronator Radii Teres,[4] by 2 heads, one *from* above the internal condyle of the humerus, the common tendon, fascia, and the intermuscular septum; the other from the inner side of the coronoid process of the ulna,—*into* a rough ridge on the outer side of the shaft of the radius, about its middle. *Action*, to pronate the hand. *Nerve*, median, which passes between the 2 heads of the muscle.

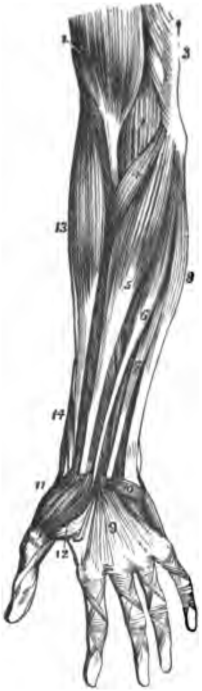
Flexor Carpi Radialis,[5] *from* the internal condyle by the common tendon, the fascia, and intermuscular septa,—*into* the base of the metacarpal bone of the index finger. *Action*, to flex the wrist. *Nerve*, median.

Palmaris Longus,[6] *from* the same origin as the flexor carpi radialis,—*into* the annular ligament and the palmar fascia.[9] *Action*, to make the palmar fascia tense. *Nerve*, median.

Flexor Carpi Ulnaris,[8] by 2 heads, one from the internal condyle by the common tendon, the other from the inner margin of the olecranon, the upper two-thirds of the posterior border of the ulna, and the intermuscular septum,—*into* the pisiform bone, the annular ligament, and the base of the 5th metacarpal bone. *Action*, to flex the wrist. *Nerve*, ulnar.

Flexor Sublimis Digitorum (Perforatus),[7] by 3 heads, one from the inner condyle by the common tendon, the internal lateral ligament, and the inter muscular septum; the 2d from the inner side of the coronoid process; the 3d from the oblique line of the radius,—*into* the lateral margins of the second

FIG. 45.



phalanges by 4 tendons which are split for the passage of the deep flexor tendons. *Action*, to flex the second phalanges. *Nerve*, median.

Flexor Profundus Digitorum (Perforans), *from* the upper two-thirds of the shaft of the ulna, a depression on the inner side of the coronoid process, and the interosseous membrane,—*into* the bases of the last phalanges, by 4 tendons which perforate the tendons of the superficial flexor. *Action*, to flex the phalanges. *Nerves*, ulnar, and anterior interosseous.

Flexor Longus Pollicis, *from* the upper two-thirds of the shaft of the radius, and the interosseous membrane,—*into* the base of the last phalanx of the thumb, which it flexes. *Nerve*, anterior interosseous.

Pronator Quadratus, *from* the oblique line on the lower one-fourth of the ulna, and the internal body of the ulna,—*into* the lower one-fourth of the external border of the shaft of the radius. *Action*, to pronate the hand. *Nerve*, anterior interosseous.

Supinator Longus,[13] *from* the upper two-thirds of the external condyloid ridge on the humerus, and the intermuscular septum,—*into* the base of the styloid process of the radius. *Action*, to supinate the hand. *Nerve*, musculo-spiral.

Extensor Carpi Radialis Longior,[e] *from* the lower one-third of the external condyloid ridge on the humerus, and the intermuscular septum,—*into* the base of the metacarpal bone of the index finger,[g] on its radial side. *Action*, to extend the wrist. *Nerve*, musculo-spiral.

Extensor Carpi Radialis Brevior,[f] *from* the external condyle by the common tendon, the external lateral ligament, and the intermuscular septa,—*into* the radial side of the base of the 3d metacarpal bone.[g] *Action*, to extend the wrist. *Nerve*, posterior interosseous.

Extensor Communis Digitorum,[h] *from* the external condyle by the common tendon, the deep fascia, and the intermuscular septa,—*into* the 2d and 3d phalanges of all the fingers, by 3 tendons, one of which divides into two. *Action*, to extend the fingers. *Nerve*, posterior interosseous.

Extensor Minimi Digiti,[i] *from* the common tendon and the intermuscular septa,—*into* the 2d and 3d phalanges of the little finger, with the tendon derived from the common extensor. *Action*, as named. *Nerve*, posterior interosseous.

Extensor Carpi Ulnaris,[j] *from* the common tendon, the middle one-third of the posterior border of the ulna, and the fascia of the forearm,—*into* the base of the 5th metacarpal bone. *Action*, to extend the wrist. *Nerve*, posterior interosseous.

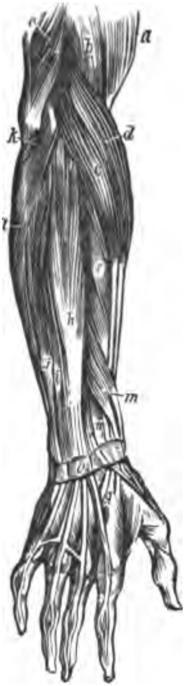
Anconeus,[k] *from* the external condyle of the humerus, posteriorly,—*into* the side of the olecranon, and upper one-third of the posterior surface of the shaft of the ulna. *Action*, to extend the forearm. *Nerve*, the musculo-spiral.

Supinator Brevis, *from* the external condyle of the humerus, the external lateral and orbicular ligaments, and an oblique line on the ulna,—*into* the inner surface of the neck of the radius, the outer edge of its bicipital tuberosity, and the oblique line. *Action*, to supinate the hand. *Nerve*, posterior interosseous, which pierces it.

Extensor Ossis Metacarpi Pollicis,[14] *from* the posterior surfaces of the shafts of the radius and ulna, and the interosseous ligament,—*into* the base of the metacarpal bone of the thumb. *Action*, to extend the thumb. *Nerve*, posterior interosseous.

Extensor Primi Internodii Pollicis,[n] *from* the posterior surface of the shaft of the radius and the interosseous membrane,—*into* the base of the 1st phalanx of the thumb. *Action*, to extend the thumb. *Nerve*, posterior interosseous.

FIG. 46.



Extensor Secundi Internodii Pollicis,[m] *from* the shaft of the ulna posteriorly and the interosseous membrane,—*into* the base of the last phalanx of the thumb. *Action*, to extend the thumb. *Nerve*, posterior interosseous.

Extensor Indicis, *from* the shaft of the ulna posteriorly and the interosseous membrane,—*into* the 2d and 3d phalanges of the index finger with the tendon of the common extensor. *Action*, to extend the index finger. *Nerve*, posterior interosseous.

FASCIÆ OF THE HAND.

Anterior Annular Ligament, *from* the pisiform and unciform bones,—*to* the tuberosity of the scaphoid and the ridge on the trapezium. It is pierced by the tendon of the flexor carpi radialis, and beneath it pass the tendons of the superficial and deep flexors and the flexor longus pollicis, also the median nerve. It is continuous with the palmar fascia and the fascia of the forearm.

Posterior Annular Ligament, *from* the ulna, cuneiform, and pisiform bones and the palmar fascia,—*to* the margin of the radius and the ridges on its posterior surface. It has 6 canals for the passage of the extensor tendons, each lined by a synovial membrane. It is continuous with the fascia of the forearm.

Palmar Fascia, ensheathes the muscles of the hand, and divides into slips for the four fingers, each slip dividing and forming tendinous arches for the passage of the flexor tendons.

MUSCLES OF THE HAND.

Abductor Pollicis,[11] *from* the ridge of the trapezium and annular ligament,—*into* the radial side of the base of the 1st phalanx of the thumb. *Action*, to draw the thumb from the median line. *Nerve*, median.

Opponens Pollicis, *from* the palmar surface of the trapezium and annular ligament,—*into* the radial side of the metacarpal bone of the thumb, for its whole length. *Action*, as a flexor ossis metacarpi pollicis. *Nerve*, median.

Flexor Brevis Pollicis,[12] *from* the trapezium, annular ligament, trapezoid, os magnum, base of the 3d metacarpal, and the sheath of the tendon of the flexor carpi radialis,—*into* both sides of the base of the 1st phalanx of the thumb, by two tendons, each of which has a sesamoid bone in it. *Action*, to flex the thumb. *Nerves*, median and ulnar.

Adductor Pollicis, *from* the whole palmar surface of the 3d metacarpal bone,—*into* the ulnar side of the base of the 1st phalanx of the thumb, and the internal sesamoid bone. *Action*, to draw the thumb towards the median line. *Nerve*, ulnar.

Thenar Eminence, or ball of the thumb, is formed by the above-named 4 muscles. The following first 4 form the *Hypo-thenar Eminence*.

Palmaris Brevis,[10] *from* the annular ligament and palmar fascia,—*into* the skin on the inner border of the palm of the hand. *Action*, to corrugate the skin of the hand. *Nerve*, ulnar.

Abductor Minimi Digiti, *from* the pisiform bone and the tendon of the flexor carpi ulnaris,—*into* the ulnar side of the base of the 1st phalanx of the little finger. *Action*, as named. *Nerve*, ulnar.

Flexor Brevis Minimi Digiti, *from* the tip of the unciform process and the annular ligament,—*into* the base of the 1st phalanx of the little finger, with the preceding muscle. *Action,* as named. *Nerve,* ulnar.

Opponens Minimi Digiti, *from* the unciform process and annular ligament,—*into* the whole ulnar margin of the 5th metacarpal bone. *Action,* a flexor of the 5th metacarpal bone. *Nerve,* ulnar.

Lumbricales (4), *from* the tendons of the deep flexor,—*into* the expanded tendons of the common extensor, on the dorsi of the phalanges. *Action,* probably to flex the 1st phalanges. *Nerves,* median and ulnar.

Dorsal Interossei (4), by 2 heads from the adjacent sides of the metacarpal bones,—*into* the bases of the 1st phalanges of the index, middle, and ring fingers, the middle finger having two. *Action,* abductors of the fingers from the median line. *Nerve,* ulnar.

Palmar Interossei (3), from the palmar surfaces of the 2d, 4th, and 5th metacarpal bones,—*into* the bases of the 1st phalanges of the same fingers. *Action,* adductors of the fingers. *Nerve,* ulnar.

MUSCLES OF THE HIP AND THIGH.

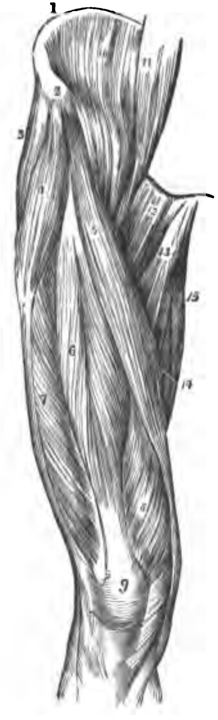
Psoas Magnus,[11] *from* the bodies, transverse processes, and intervertebral substances of the last dorsal and all the lumbar vertebræ,—*into* the lesser trochanter of the femur, by a common tendon with the iliacus. *Action,* to flex and rotate the femur outwards, also to flex the trunk and pelvis on the thigh. *Nerves,* anterior lumbar branches.

Psoas Parvus, *from* the bodies of the last dorsal and first lumbar vertebræ, and the intervertebral substance,—*into* the ilio-pectineal eminence, and the iliac fascia. *Action,* when present it is a tensor of the iliac fascia. *Nerves,* anterior lumbar branches.

liacus,[10] *from* the iliac fossa, inner margin of the iliac crest, ilio-lumbar ligament, base of the sacrum, anterior spinous processes of the ilium and the notch between them, and from the capsule of the hip-joint,—*into* the outer side of the tendon of the psoas magnus. *Action,* the same as the psoas magnus. *Nerve,* anterior crural.

ASCIA LATA, the deep fascia of the thigh, extends from Poupart's ligament to the prominent points around the knee-joint, and from the margin of the sacrum and coccyx around the limb to the pubic arch and pectineal line. It sends two strong intermuscular septa down to the linea aspera, and contains the *Saphenous Opening,* which is formed by the reflected margins of its pubic and iliac portions. *Poupart's Ligament* is made by the knife, and is only the line of junction between the aponeurosis of the external oblique muscle and the fascia lata; extending from the anterior superior spine o the ilium to the spine of the pubic bone.

FIG. 47.



Tensor Vaginæ Femoris,[4] *from* the anterior part o the outer lip of the iliac crest, and the anterio superior spinous process,—*into* the fascia lata later ally, for one-fourth down the thigh. *Action,* tensor of the fascia lata. *Nerve,* superior gluteal.

Sartorius,[5] *from* the anterior superior spine of th ilium[2] and half of the notch below it,—*into* the upper internal surface of the shaft of the tibia. *Action,* to flex and cross the legs. *Nerve,* anterior crural.

Quadriceps Extensor, includes the rectus, vastus internus and externus, and the crureus muscles. Its tendon contains the patella.

Rectus Femoris,[6] by two tendons, *the Straight* from the anterior inferior spine of the ilium, *the Reflected* from a groove above the brim of the acetabulum, —*into* the tuberosity of the tibia by the tendon[9] common to this and the next 3 muscles. *Action,* to extend the leg. *Nerve,* anterior crural.

Vastus Externus,[7] *from* the anterior border of the great trochanter and the whole length of the linea aspera,—*into* the tuberosity of the tibia, by the common tendon.

Vastus Internus[8] **and Crureus** are one muscle, arisi *from* the inner lip of the linea aspera and near the whole of the shaft of the femur in front a laterally from the trochanters down to within t lower one-fourth of the bone,—*into* the tuberosity of the tibia by the comm extensor tendon. *Action,* to extend the leg. *Nerve,* anterior crural.

Subcrureus, *from* the lower part of the femur anteriorly,—*into* the synov pouch behind the patella. *Action,* to draw up the synovial sac. *Ner* anterior crural.

Gracilis,[15] *from* the inner margin of the rami of the pubes and ischium,—i the inner surface of the shaft of the tibia below the tuberosity. *Action,* flex and adduct the leg. *Nerve,* obturator.

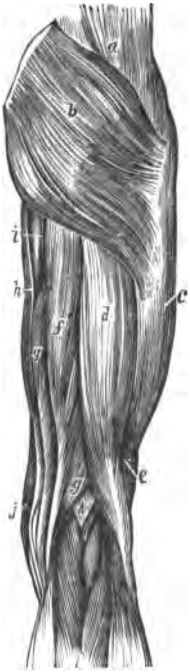
Pectineus,[12] *from* the ilio-pectineal line, and the bone in front thereof, a from an expansion of Gimbernat's ligament,—*into* the rough line extendi from the trochanter minor to the linea aspera. *Action*, to flex the thigh and rotate it outwards. *Nerves*, obturator, accessory obturator, and anterior crural.

Adductor Longus,[13] *from* the front of the pubes,—*into* the middle third of the linea aspera. *Action*, to adduct the thigh and flex it. *Nerve*, obturator.

Adductor Brevis, *from* the descending ramus of the pubes,—*into* the upper part of the linea aspera. *Action*, to adduct and flex the thigh. *Nerve*, obturator.

Adductor Magnus,[14] *from* the rami of the pubes and ischium, and the outer margin and under surface of the tuberosity of the ischium,—*into* the rough line leading from the great trochanter to the linea aspera, the whole length of the linea aspera, and by a tendon into the tubercle above the inner condyle of the femur. *Action*, to adduct the thigh and rotate it outwards. *Nerves*, obturator and great sciatic. This muscle is pierced by 4 apertures for the 3 superior perforating and the profunda arteries, and about the lower one-third of its insertion an angular interval is left therein, the lower opening of Hunter's canal, for the passage of the femoral vessels into the popliteal space.

FIG. 48.



Gluteus Maximus,[b] *from* the superior curved line of the ilium, the crest behind it, the last piece of the sacrum, the side of the coccyx and the great and posterior sacro-sciatic ligaments,—*into* the fascia lata and the rough line leading from the great trochanter to the linea aspera. *Action*, to extend and abduct the thigh and rotate it outwards, also to maintain the trunk erect. *Nerves*, inferior gluteal and a branch from the sacral plexus.

Gluteus Medius,[a] *from* the ilium between the superior and middle curved lines, the crest between them and the fascia of the part,—*into* the oblique lines on the great trochanter. *Action*, its posterior fibres rotate the thigh outwards, its anterior fibres rotate inwards. It also abducts the thigh and draws it forwards, and assists to maintain the trunk erect. *Nerve*, superior gluteal.

Gluteus Minimus,[8] *from* the ilium between the middle and inferior curved lines, and the margin of the great sacro-sciatic notch,—*into* the anterior border of the great trochanter. *Action*, to rotate the thigh inwards, also to abduct and draw it forwards, and to maintain the trunk erect. *Nerve*, superior gluteal.

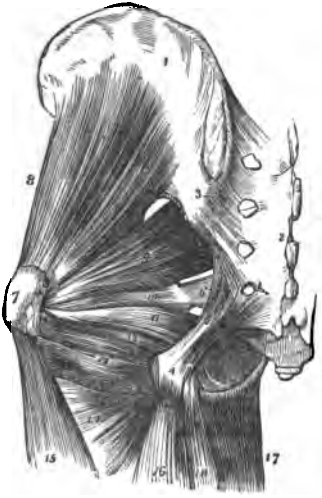
Pyriformis,[9] by 3 digitations from the front of the sacrum, from the margin of the great sacro-sciatic foramen and the great sacro-sciatic ligament,—*into* the upper border of the great trochanter,[7] having passed through the great sacro-sciatic foramen. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

Obturator Internus,[11] *from* the posterior bony margin of the obturator foramen and the inner surface of the obturator membrane,—*into* the great trochanter,[7] passing through the lesser sacro-sciatic notch. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

Gemellus Superior,[10] *from* the outer surface of the spine of the ischium,—*into* the great trochanter, being blended with the tendon of the obturator internus. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

Gemellus Inferior,[12] *from* the tuberosity of the ischium,—*into* the tendon of the obturator internus and the great trochanter. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

FIG. 49.



Obturator Externus, *from* the anterior inner bony margin of the obturator foramen, and the inner two-thirds of the anterior surface of the obturator membrane,—*into* the digital fossa of the femur at the inner base of the great trochanter. *Action*, an external rotator of the thigh. *Nerve*, obturator.

Quadratus Femoris,[13] *from* the tuberosity of the ischium,—*into* the upper part of the linea quadrati on the trochante major posteriorly. *Action*, an extern rotator of the thigh. *Nerves*, branch from the sacral plexus.

Biceps,[16] by 2 heads, the *Long Head*[d] fro the tuberosity of the ischium posteri- orly, the *Short Head*,[e] from the oute lip of the linea aspera, and the inter- muscular septum,—*into* the outer si of the head of the fibula; its tendon embracing the external lateral ligame of the knee-joint, and forming the *Outer Hamstring*, the tendons of the sem tendinosus, semi-membranosus, gracilis, and sartorius, forming the *Inner Hamstring*. *Action*, to flex the leg and rotate it outwards. *Nerve*, great sciatic.

Semi-tendinosus,*f* *from* the tuberosity of the ischium by a tendon[4] common to it and the long head of the biceps, and from the adjacent aponeurosis,—*into* the shaft of the tibia at its upper and inner surface, its tendon curving around the inner tuberosity. *Action*, to flex the leg upon the thigh. *Nerve*, great sciatic.

Semi-membranosus,*g* *from* the tuberosity of the ischium above the origin of the above-named muscles,—*into* the inner tuberosity of the tibia; its tendon dividing into 3 parts, one over the popliteus muscle, and another forming the posterior ligament of the knee-joint. *Action*, to flex the leg, and rotate it inwards. *Nerve*, great sciatic.

External Rotators of the Hip-joint are 12½,—the 3 adductors, pyriformis, 2 obturators, 2 gemelli, pectineus, psoas magnus, iliacus, sartorius, and posterior half of the gluteus medius.

Internal Rotators of the Hip-joint are 2½,—the tensor vaginæ femoris, gluteus minimus, and the anterior half of the gluteus medius.

MUSCLES OF THE LEG.

Muscles of the leg arranged in groups of threes. (Pancoast.)

Tibialus Anticus.		*Tibialus Posticus.*
Extensor Proprius Pollicis.		*Flexor Longus Pollicis.*
Extensor Longus Digitorum.		*Flexor Longus Digitorum.*
Gastrocnemius.		*Peroneus Longus.*
Soleus.		*Peroneus Brevis.*
Plantaris.	*Popliteus.*	*Peroneus Tertius.*

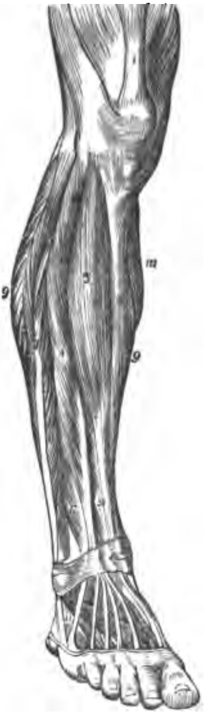
Tibialis Anti′cus[3] (Flexor Tarsi Tibialis), *from* the outer tuberosity and upper two-thirds of the shaft of the tibia externally, the interosseous membrane, deep fascia, and intermuscular septum,—through the inner canal in the anterior annular ligament *into* the inner and plantar surface of the internal cuneiform bone, and the base of the 1st metatarsal. *Action*, to flex the tarsus on the leg, and elevate the inner border of the foot. *Nerve*, anterior tibial.

Extensor Proprius Pollicis,[5] *from* the middle two-fourths of the fibula anteriorly and the interosseous membrane,—through the 2d canal in the anterior annular ligament,—*into* the base of the last phalanx of the great toe. *Action*, to extend that toe. *Nerve*, anterior tibial.

Extensor Longus Digitorum,[4] *from* the outer tuberosity of the tibia, the upper three-fourths of the shaft of the fibula anteriorly, interosseous membrane, deep fascia, and intermuscular septa,—*into* the 2d and 3d phalanges of the

4 lesser toes, by 4 tendons which pass over the dorsum of the foot, from the outer canal in the anterior annular ligament. *Action*, to extend the lesser toes. *Nerve*, anterior tibial.

FIG. 50.



Peroneus Tertius[6] (Flexor Tarsi Fibularis), *from* the outer lower one-fourth of the fibula, interosseous membrane, and intermuscular septum,—*into* the base of the 5th metatarsal bone. This muscle is a part of the last named, and passes through the same canal in the annular ligament. *Action*, to flex the tarsus. *Nerve*, anterior tibial.

Gastrocnemius, by 2 heads *from* the condyles of the femur, and the supra-condyloid ridges,—unites with the tendon of the soleus to form the *tendo Achillis*, into the posterior tuberosity of the os calcis. *Action*, to extend the foot. *Nerve*, internal popliteal.

Soleus, *from* the head and upper one-half of the shaft of the fibula posteriorly, the oblique line of the tibia, and the tendinous arch,—unites with the tendon of the gastrocnemius as the *tendo Achillis* (see above). *Action*, to extend the foot. *Nerve*, internal popliteal.

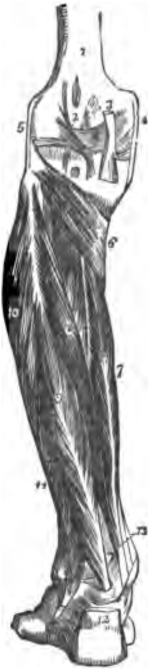
Plantaris, *from* the outer bifurcation of the linea aspera, and posterior ligament of the knee-joint, by a very long, delicate tendon,—*into* the posterior surface of the os calcis. *Action*, to extend the foot. *Nerve*, internal popliteal.

Popliteus,[6] *from* a depression on the external condyle of the femur, and the posterior ligament of the knee-joint,—*into* the inner two-thirds of the triangular surface on the shaft of the tibia posteriorly and above the oblique line. *Action*, to flex the leg. *Nerve*, internal popliteal.

Flexor Longus Pollicis,[9] *from* the lower two-thirds of the shaft of the fibula internally, the interosseous membrane, fascia, and intermuscular septum,—through grooves in the tibia, astragalus, and os calcis,—*into* the base of the last phalanx of the great toe. *Action*, to flex the great toe. *Nerve*, posterior tibial.

Flexor Longus Digitorum,[7] *from* the shaft of the tibia posteriorly and below the oblique line, and the intermuscular septum,—passes behind the inner malleolus in a groove[13] with the tibialis posticus,—*into* the bases of

FIG. 51.



the last phalanges of the lesser toes by 4 tendons which perforate the tendons of the flexor brevis digitorum. *Action*, to flex the phalanges and extend the foot. *Nerve*, posterior tibial.

Tibialis Posti′cus,[8] by two processes between which pass the anterior tibial vessels, *from* the upper one-half of shaft of the tibia posteriorly, the upper two-thirds of the shaft of the fibula internally, the interosseous membrane, deep fascia, and intermuscular septa,—passes behind the inner malleolus in a groove[13] with the long flexor, *into* the tuberosity of the scaphoid and internal cuneiform bones. *Action*, to extend the tarsus, and invert the foot. *Nerve*, posterior tibial.

Peroneus Longus,[10] *from* the head of the fibula and the upper two-thirds of its shaft externally, the deep fascia, and intermuscular septa,—passes behind the outer malleolus in a groove with the peroneus brevis, through a groove in the cuboid bone, to the outer side of the base of the 1st metatarsal bone. *Action*, to extend and evert the foot. *Nerve*, musculo-cutaneous.

Peroneus Brevis,[11] *from* the middle one-third of the shaft of the fibula externally, and the intermuscular septa,—passes behind the external malleolus in a groove with the long peroneal, *into* the dorsum of the base of the 5th metatarsal bone. *Action*, to extend the foot. *Nerve*, musculo-cutaneous branch of external popliteal.

FASCIÆ OF THE FOOT.

ANTERIOR ANNULAR LIGAMENT, consists of vertical and horizontal portions, is attached to the lower ends of the fibula and tibia, the os calcis and the plantar fascia. It contains 5 sheaths lined by synovial membranes for the tendons of the extensor muscles, that of the extensor proprius pollicis passing beneath it, as also the anterior tibial vessels and nerve.

INTERNAL ANNULAR LIGAMENT, *from* the inner malleolus *to* the os calcis, converting 3 bony grooves into canals lined by synovial membranes for the flexor tendons and the posterior tibial vessels and nerve.

EXTERNAL ANNULAR LIGAMENT, *from* the outer malleolus *to* the os calcis, binding down the peronei tendons in one synovial sac.

PLANTAR FASCIA, the densest in the body, divided into a central and two lateral portions, and attached to the inner tuberosity of the os calcis, divides into 5 processes, 1 for each toe, and several intermuscular septa.

MUSCLES OF THE FOOT.

Extensor Brevis Digitorum, the only muscle on the dorsum of the foot, arises *from* the os calcis externally, the astragalo-calcanean and the anterior annular ligaments,—by 4 tendons, 1 into the 1st phalanx of the great toe, and the others into the outer sides of the long extensor tendons of the 2d, 3d, and 4th toes. *Action*, to extend the toes. *Nerve*, anterior tibial.

Muscles on the sole of the foot (19), by layers:—

1st Layer.

Flexor Brevis Digitorum.
Abductor Pollicis.
Abductor Minimi Digiti.

2d Layer.

Flexor Accessorius.
Lumbricales (4).

3d Layer.

Flexor Brevis Pollicis.
Flexor Brevis Minimi Digiti. } Pancoast's Triangle, the lowest in the body.
Adductor Pollicis. }
Transversus Pedis. }

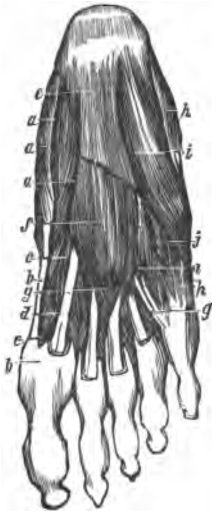
4th Layer.

Interossei (4 Dorsal, 3 Plantar).

Abductor Pollicis,*a* *from* the inner tuberosity of the os calcis, the internal annular ligament, plantar fascia, and intermuscular septum,—*into* the inner side of the base of the 1st phalanx of the great toe. *Action*, to abduct the great toe. *Nerve*, internal plantar.

Flexor Brevis Digitorum,*f* *from* the inner tuberosity of the os calcis, the plantar fascia and intermuscular septa,—*into* the sides of the 2d phalanges of the lesser toes by 4 tendons which are perforated for the long flexor tendons. *Action*, to flex the lesser toes. *Nerve*, internal plantar.

FIG. 52.



Abductor Minimi Digiti,*h* *from* the outer tuberosity and under surface of the os calcis, the plantar fascia and the intermuscular septum,—*into* the base of the 1st phalanx of the little toe with the tendon of its short flexor. *Action*, to abduct the little toe. *Nerve*, external plantar.

Flexor Accessorius, by 2 heads, *from* the os calcis and the calcaneo-scaphoid and long plantar ligaments,—*into* the tendon of the flexor longus digitorum. *Action*, accessory flexor of the toes. *Nerve*, external plantar.

Lumbricales*g* (4), *from* the long flexor tendons —*into* the inner side of the second phalanges of the lesser toes. *Action*, accessory flexors. *Nerves*, internal plantar to the two internal, external plantar to the others.

Flexor Brevis Pollicis,[c] *from* the cuboid and external cuneiform bones, and the prolonged tendon of the tibialis posticus,—*into* both sides of the base of the 1st phalanx of the great toe, by 2 portions, of which one blends with the abductor pollicis, the other with the adductor pollicis. *Action*, to flex the great toe. *Nerve*, internal plantar.

Adductor Pollicis, *from* the tarsal ends of the three middle metatarsal bones, and the sheath of the tendon of the peroneus longus,—*into* the base of the 1st phalanx of the great toe, externally. *Action*, to adduct the great toe. *Nerve*, external plantar.

Flexor Brevis Minimi Digiti,[i] *from* the base of the 5th metatarsal bone and the sheath of the tendon of the peroneus longus,—*into* the base of the 1st phalanx of the little toe externally. *Action*, to flex the little toe. *Nerve*, external plantar.

Transversus Pedis, *from* the under surface of the head of the 5th metatarsal bone, and the transverse ligament of the metatarsus,—*into* the outer side of the 1st phalanx of the great toe, blending with the tendon of the adductor pollicis. *Action*, to adduct the great toe. *Nerve*, external plantar.

Dorsal Interossei (4), each by two heads *from* the adjacent sides of two metatarsal bones,—*into* the base of the 1st phalanx of the corresponding toe. *Action*, to abduct the toes. *Nerve*, external plantar.

Plantar Interossei[j] (3), *from* the shafts of the 3d, 4th, and 5th metatarsal bones,—*into* the bases of the 1st phalanges of the same toes. *Action*, to adduct the toes towards the median line. *Nerve*, external plantar.

THE HEART.

What is the Pericardium? It is a conical membranous closed sac, containing the heart and the roots of the great vessels. It lies behind the sternum and between the pleuræ, its apex upwards, its base below and attached to the central tendon of the diaphragm. It is composed of an outer fibrous coat, and an inner serous one; the latter consisting of two portions, a parietal layer, lining the inner surface of the fibrous coat, and a visceral layer, which is reflected over the heart and vessels. The serous portion secretes a thin fluid, about 1 drachm in quantity normally, for the lubrication of its surfaces. The fibrous coat is prolonged on the outer surfaces of the great vessels, except the inferior vena cava, and becomes continuous with the deep layer of the cervical fascia.

Describe the Endocardium. It is a serous membrane which lines the inner surface of the heart, forming by its reduplications the cardiac, aortic, and pulmonary valves, and continuous with the lining membrane of the great vessels.

Describe the Heart. It is a hollow muscular organ, conoidal in shape, placed obliquely in the chest between the lungs, base upwards, apex towards the left and front, corresponding to the interspace between the 5th and 6th costal cartilages, one inch inside of and two inches below the left nipple. In the adult its size is about 5 inches by 3½ by 2½, and from 8 to 12 oz. in weight.

What are the Cavities of the Heart? They are 4 in number, an auricle and a ventricle on each side of the heart, separated by a longitudinal muscular septum, and indicated on the external surface of the organ by grooves, named, from their contiguous cavities, as the *Auriculo-ventricular Groove* transversely, and the *Inter-Ventricular Groove* longitudinally.

Describe the Right Auricle. It is larger than the left, can hold about 2 fluidounces, its walls being about 1 line in thickness. It receives the venous blood by the superior and inferior venæ cavæ and the coronary sinus, and presents interiorly the following points for examination:—

Appendix Auriculæ, a conical pouch projecting from the auricle to the front and left, its margins being dentated.

Openings of the superior and inferior venæ cavæ and the coronary sinus, the latter having a valve in two segments.

Foramina Thebesii, several minute orifices, the mouths of veins from the substance of the heart.

Tubercle of Lower, a very small projection on the right wall, supposed to influence the direction of the blood-current.

Eustachian Valve, at the anterior margin of the inferior vena cava; large in the fœtus, to direct the blood to the foramen ovale.

Fossa Ovalis, a depression on the inner wall, and the situation of the foramen ovale in the fœtus.

Annulus Ovalis, the oval margin of the fossa ovalis.

Musculi Pectinati, muscular columns on the inner surface of the appendix and the inner wall of the auricle.

Auriculo-ventricular Opening, communicates with the right ventricle, is oval, about an inch broad, surrounded by a fibrous ring, and is guarded by the tricuspid valve.

Describe the Right Ventricle. Its form is conical, its cavity containing about 2 fluidounces, its apex above the apex of the heart, and it presents interiorly the following, viz.—

Tricuspid Valve, consists of 3 triangular segments connected by their bases with the auriculo-ventricular orifice, and by their sides with each other, the largest being on the left side.

Chordæ Tendinæ, delicate tendinous cords which connect the margins and lower surfaces of the tricuspid valve with the columnæ.

Columnæ Carneæ, muscular columns projecting from the surface of the ventricle, of which 3 or 4, called *Columnæ Papillares*, give attachment to the chordæ tendinæ.

Semilunar Valves, are 3 in number, and guard the orifice of the pulmonary artery, each about the middle of its free margin has a fibro-cartilaginous nodule, the *Corpus Arantii*, which more perfectly closes the orifice.

Opening of the Pulmonary Artery, at the superior and internal angle of the ventricle, the *Conus Arteriosus*. It is circular in form, surrounded by a fibrous ring, and is guarded by the semilunar valves.

Sinuses of Valsalva, are 3 pouches, one behind each valve, between it and the commencement of the pulmonary artery.

Describe the Left Auricle. Its walls are about 1½ lines in thickness, its capacity rather less than 2 fluidounces, has an appendix auriculæ, and receives the arterialized blood from the lungs. It presents the following internally:—

Openings of the Pulmonary Veins, are 4 in number, sometimes 3, as the two left veins frequently end in a common opening.

Left Auriculo-ventricular Opening, is smaller than the right one.

Musculi Pectinati, on the inner surface of the appendix.

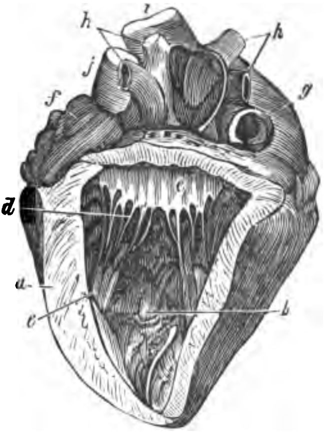
Depression, corresponding to the fossa ovalis in the right auricle.

Describe the Left Ventricle. It is longer, thicker, and more conical than the right, projecting towards the posterior aspect. Its walls^a are the thickest of those in the heart, being twice as thick as those of the right ventricle. Its interior presents the following:—

Aortic Opening, is small and circular, placed in front and to the right of the auriculo-ventricular, a segment of the mitral valve being between them. It is surrounded by a fibrous ring, and guarded by semilunar valves.

Mitral Valve,^{c} consists of two unequal-sized segments, and is attached to the fibrous ring which surrounds the auriculo-ventricular opening. Its margins are connected with the ventricular walls by *Chordæ Tendinæ*^{d} and *Musculi Papillares.*

FIG. 53.



Semilunar Valves, guard the aortic orifice, and are larger and stronger than those on the right side.

Sinus Aortici, or sinus of Valsalva, a pouch between each valve and the beginning of the aorta.

Columnæ Carneæ,[e] are smaller and more numerous than on the right side; the *Musculi Papillares* are but two in number.

Describe the Structure of the Heart. The muscular fibres take origin from the four fibrous rings at the auriculo-ventricular and aortic openings. The fibres of the auricles are arranged in two layers, a superficial and a deep one, the latter having looped fibres and annular fibres. In the ventricles the fibres are superficial and deep, the latter being arranged circularly, the former spirally, coiling inwards at the apex of the heart into a whorl-like form, the *vortex*.

THE ARTERIES.

What are the Arteries? Cylindrical vessels which carry arterial blood to the body from the heart. Those going to the lungs with the returning veins, form the *Lesser or Pulmonic Circulation.* The aorta with its branches and the returning veins, constitute the *Greater or Systemic Circulation.* The arteries anastomose or communicate freely with each other everywhere throughout the body, permitting the establishment of collateral circulations.

Describe the Structure of the Arteries. They are dense, very elastic, preserving their cylindrical form, and are composed of 3 coats, *an Internal* or serous; *a Middle*, which is of muscular and elastic tissue; and *an External*, of connective tissue. They are generally included in a fibro-areolar investment, the *Sheath*, which also encloses the accompanying veins. The larger arteries are nourished by the *Vasa Vasorum*, blood-vessels which ramify in the external and middle coats; and are supplied with nerves, the *Vaso-motor*, derived from both the sympathetic and cerebro-spinal systems, and forming intricate plexuses on the larger trunks.

What are the Capillaries? Minute vessels forming a network throughout the tissues of the body between the terminating arteries and the commencing veins. Their average diameter is about the $\frac{1}{3000}$ of an inch, and their walls consist of a transparent homogeneous membrane continuous with the innermost layer of the arterial and venous walls.

[In the following pages, main branches are in italics, sub-branches in Roman.]

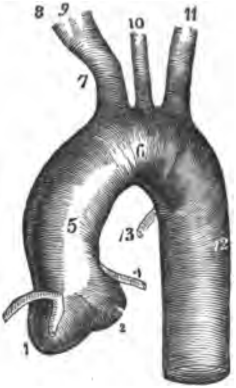
Describe the Aorta. It is the main trunk of the systemic arteries, commencing at the aortic opening of the left ventricle of the heart, arching backwards over the roof of the left lung into the thorax, where it descends on the left of the spinal column, and after passing through the aortic opening in the diaphragm, it terminates in the right and left common iliac arteries opposite the 4th lumbar vertebra. It is divided into the arch, the thoracic aorta, and the abdominal aorta; and the arch is subdivided into the ascending,[5] transverse,[6] and descending [12] portions. The upper border of the arch is generally situated about an inch below the upper margin of the sternum. The branches of the aorta are,—

From the Arch,—*2 Coronary.*[4] *Left Common Carotid.*[10]
Innominate.[7] *Left Subclavian.*[11]
From the Thoracic,—*Pericardiac.* *Œsophageal.* *20 Intercostals.*
Bronchial. *Posterior Mediastinal.*
From the Abdominal,—*2 Phrenic.*
Cœliac Axis. { *Gastric.* *Hepatic.* *Splenic.* } *2 Spermatic.* *Inferior Mesenteric.* *8 Lumbar.*
Superior Mesenteric. *Sacra Media.*
2 Supra-renal. *2 Common Iliac.*
2 Renal.

Describe the Coronary Arteries. They are 2 in number, a right and a left,[4] arise from the aorta behind the semilunar valves and run in the vertical grooves of the heart, the left artery in front, to supply the tissue of that organ.

Describe the Innominate.[7] It arises from the summit of the arch of the aorta, is 1½ inch long, and divides behind the right sterno-clavicular joint into the *Right Common Carotid*[9] and *Right Subclavian*,[8] these arteries on the left side of the body arising directly from the arch of the aorta.[10] [11] It sometimes sends off a *Middle Thyroid* (artery of Neubauer) which may arise directly from the arch of the aorta. The innominate is sometimes absent, and not infrequently varies in length from an inch to two or more.

FIG. 54.



Describe the Common Carotid. Arising differently (see above), the two carotids are similarly described, except that the left is longer and deeper than the right one. Their course is indicated by a line drawn from a point midway between the angle of the lower jaw and the mastoid process to the sterno-clavicular articulation. At the lower part of the neck they are separated only by the width of the trachea, and they are each contained in a sheath of the deep cervical fascia with the internal jugular vein externally and the pneumogastric nerve between the artery and vein. On the front of the sheath lies the descendens noni nerve (descending branch of the 9th or hypoglossal). The artery lies beneath the inner border of the sterno-cleido-mastoid muscle, and is crossed about its middle by the omo-hyoid muscle and the middle thyroid vein.

border of the great trochanter. *Action*, to rotate the thigh inwards, also to abduct and draw it forwards, and to maintain the trunk erect. *Nerve*, superior gluteal.

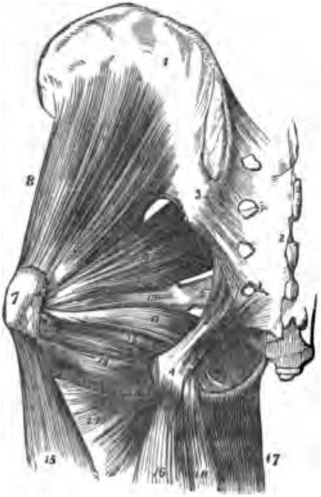
Pyriformis,[9] by 3 digitations from the front of the sacrum, from the margin of the great sacro-sciatic foramen and the great sacro-sciatic ligament,—*into* the upper border of the great trochanter,[7] having passed through the great sacro-sciatic foramen. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

Obturator Internus,[11] *from* the posterior bony margin of the obturator foramen and the inner surface of the obturator membrane,—*into* the great trochanter,[7] passing through the lesser sacro-sciatic notch. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

Gemellus Superior,[10] *from* the outer surface of the spine of the ischium,—*into* the great trochanter, being blended with the tendon of the obturator internus. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

Gemellus Inferior,[12] *from* the tuberosity of the ischium,—*into* the tendon of the obturator internus and the great trochanter. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

FIG. 49.



Obturator Externus, *from* the anterior inner bony margin of the obturator foramen, and the inner two-thirds of the anterior surface of the obturator membrane,—*into* the digital fossa of the femur at the inner base of the great trochanter. *Action*, an external rotator of the thigh. *Nerve*, obturator.

Quadratus Femoris,[13] *from* the tuberosity of the ischium,—*into* the upper part of the linea quadrati on the trochanter major posteriorly. *Action*, an external rotator of the thigh. *Nerves*, branches from the sacral plexus.

Biceps,[16] by 2 heads, the *Long Head*[d] from the tuberosity of the ischium posteriorly, the *Short Head*,[e] from the outer lip of the linea aspera, and the intermuscular septum,—*into* the outer side of the head of the fibula; its tendon embracing the external lateral ligament of the knee-joint, and forming the *Outer Hamstring*, the tendons of the semi-tendinosus, semi-membranosus, gracilis, and sartorius, forming the *Inner Hamstring*. *Action*, to flex the leg and rotate it outwards. *Nerve*, great sciatic.

Semi-tendinosus,*f* *from* the tuberosity of the ischium by a tendon[4] common to it and the long head of the biceps, and from the adjacent aponeurosis,—*into* the shaft of the tibia at its upper and inner surface, its tendon curving around the inner tuberosity. *Action*, to flex the leg upon the thigh. *Nerve*, great sciatic.

Semi-membranosus,*g* *from* the tuberosity of the ischium above the origin of the above-named muscles,—*into* the inner tuberosity of the tibia; its tendon dividing into 3 parts, one over the popliteus muscle, and another forming the posterior ligament of the knee-joint. *Action*, to flex the leg, and rotate it inwards. *Nerve*, great sciatic.

External Rotators of the Hip-joint are 12½,—the 3 adductors, pyriformis, 2 obturators, 2 gemelli, pectineus, psoas magnus, iliacus, sartorius, and posterior half of the gluteus medius.

Internal Rotators of the Hip-joint are 2½,—the tensor vaginæ femoris, gluteus minimus, and the anterior half of the gluteus medius.

MUSCLES OF THE LEG.

Muscles of the leg arranged in groups of threes. (Pancoast.)

Tibialus Anticus.		*Tibialus Posticus.*
Extensor Proprius Pollicis.		*Flexor Longus Pollicis.*
Extensor Longus Digitorum.		*Flexor Longus Digitorum.*
Gastrocnemius.		*Peroneus Longus.*
Soleus.		*Peroneus Brevis.*
Plantaris.	*Popliteus.*	*Peroneus Tertius.*

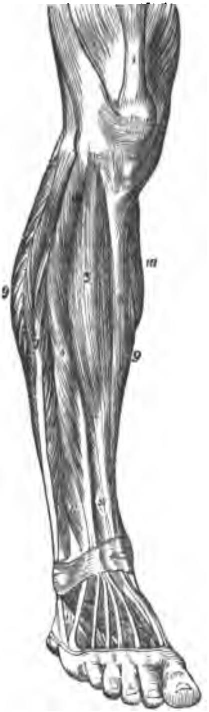
Tibialis Anti'cus[3] (Flexor Tarsi Tibialis), *from* the outer tuberosity and upper two-thirds of the shaft of the tibia externally, the interosseous membrane, deep fascia, and intermuscular septum,—through the inner canal in the anterior annular ligament *into* the inner and plantar surface of the internal cuneiform bone, and the base of the 1st metatarsal. *Action*, to flex the tarsus on the leg, and elevate the inner border of the foot. *Nerve*, anterior tibial.

xtensor Proprius Pollicis,[5] *from* the middle two-fourths of the fibula anteriorly and the interosseous membrane,—through the 2d canal in the anterior annular ligament,—*into* the base of the last phalanx of the great toe. *Action*, to extend that toe. *Nerve*, anterior tibial.

xtensor Longus Digitorum,[4] *from* the outer tuberosity of the tibia, the upper three-fourths of the shaft of the fibula anteriorly, interosseous membrane, deep fascia, and intermuscular septa,—*into* the 2d and 3d phalanges of the

4 lesser toes, by 4 tendons which pass over the dorsum of the foot, from the outer canal in the anterior annular ligament. *Action*, to extend the lesser toes. *Nerve*, anterior tibial.

FIG. 50.



Peroneus Tertius[6] (Flexor Tarsi Fibularis), *from* the outer lower one-fourth of the fibula, interosseous membrane, and intermuscular septum,—*into* the base of the 5th metatarsal bone. This muscle is a part of the last named, and passes through the same canal in the annular ligament. *Action*, to flex the tarsus. *Nerve*, anterior tibial.

Gastrocnemius, by 2 heads *from* the condyles of the femur, and the supra-condyloid ridges,—unites with the tendon of the soleus to form the *tendo Achillis*, into the posterior tuberosity of the os calcis. *Action*, to extend the foot. *Nerve*, internal popliteal.

Soleus, *from* the head and upper one-half of the shaft of the fibula posteriorly, the oblique line of the tibia, and the tendinous arch,—unites with the tendon of the gastrocnemius as the *tendo Achillis* (see above). *Action*, to extend the foot. *Nerve*, internal popliteal.

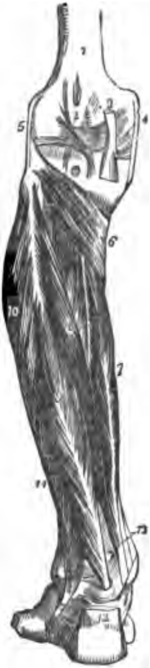
Plantaris, *from* the outer bifurcation of the linea aspera, and posterior ligament of the knee-joint, by a very long, delicate tendon,—*into* the posterior surface of the os calcis. *Action*, to extend the foot. *Nerve*, internal popliteal.

Popliteus,[6] *from* a depression on the external condyle of the femur, and the posterior ligament of the knee-joint,—*into* the inner two-thirds of the triangular surface on the shaft of the tibia posteriorly and above the oblique line. *Action*, to flex the leg. *Nerve*, internal popliteal.

Flexor Longus Pollicis,[9] *from* the lower two-thirds of the shaft of the fibula internally, the interosseous membrane, fascia, and intermuscular septum,—through grooves in the tibia, astragalus, and os calcis,—*into* the base of the last phalanx of the great toe. *Action*, to flex the great toe. *Nerve*, posterior tibial.

Flexor Longus Digitorum,[7] *from* the shaft of the tibia posteriorly and below the oblique line, and the intermuscular septum,—passes behind the inner malleolus in a groove[13] with the tibialis posticus,—*into* the bases of

FIG. 51.



the last phalanges of the lesser toes by 4 tendons which perforate the tendons of the flexor brevis digitorum. *Action*, to flex the phalanges and extend the foot. *Nerve*, posterior tibial.

Tibialis Posti′cus,[8] by two processes between which pass the anterior tibial vessels, *from* the upper one-half of shaft of the tibia posteriorly, the upper two-thirds of the shaft of the fibula internally, the interosseous membrane, deep fascia, and intermuscular septa,—passes behind the inner malleolus in a groove [13] with the long flexor, *into* the tuberosity of the scaphoid and internal cuneiform bones. *Action*, to extend the tarsus, and invert the foot. *Nerve*, posterior tibial.

Peroneus Longus,[10] *from* the head of the fibula and the upper two-thirds of its shaft externally, the deep fascia, and intermuscular septa,—passes behind the outer malleolus in a groove with the peroneus brevis, through a groove in the cuboid bone, to the outer side of the base of the 1st metatarsal bone. *Action*, to extend and evert the foot. *Nerve*, musculo-cutaneous.

Peroneus Brevis,[11] *from* the middle one-third of the shaft of the fibula externally, and the intermuscular septa,—passes behind the external malleolus in a groove with the long peroneal, *into* the dorsum of the base of the 5th metatarsal bone. *Action*, to extend the foot. *Nerve*, musculo-cutaneous branch of external popliteal.

FASCIÆ OF THE FOOT.

ANTERIOR ANNULAR LIGAMENT, consists of vertical and horizontal portions, is attached to the lower ends of the fibula and tibia, the os calcis and the plantar fascia. It contains 5 sheaths lined by synovial membranes for the tendons of the extensor muscles, that of the extensor proprius pollicis passing beneath it, as also the anterior tibial vessels and nerve.

INTERNAL ANNULAR LIGAMENT, *from* the inner malleolus *to* the os calcis, converting 3 bony grooves into canals lined by synovial membranes for the flexor tendons and the posterior tibial vessels and nerve.

EXTERNAL ANNULAR LIGAMENT, *from* the outer malleolus *to* the os calcis, binding down the peronei tendons in one synovial sac.

PLANTAR FASCIA, the densest in the body, divided into a central and two lateral portions, and attached to the inner tuberosity of the os calcis, divides into 5 processes, 1 for each toe, and several intermuscular septa.

MUSCLES OF THE FOOT.

Extensor Brevis Digitorum, the only muscle on the dorsum of the foot, arises *from* the os calcis externally, the astragalo-calcanean and the anterior annular ligaments,—by 4 tendons, 1 into the 1st phalanx of the great toe, and the others into the outer sides of the long extensor tendons of the 2d, 3d, and 4th toes. *Action,* to extend the toes. *Nerve,* anterior tibial.

Muscles on the sole of the foot (19), by layers:—

1st Layer.
Flexor Brevis Digitorum.
Abductor Pollicis.
Abductor Minimi Digiti.

2d Layer.
Flexor Accessorius.
Lumbricales (4).

3d Layer.
Flexor Brevis Pollicis.
Flexor Brevis Minimi Digiti.
Adductor Pollicis.
Transversus Pedis.

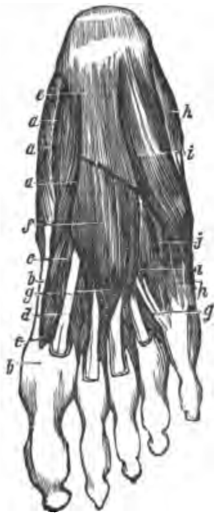
} Pancoast's Triangle, the lowest in the body.

4th Layer.
Interossei (4 Dorsal, 3 Plantar).

Abductor Pollicis,[a] *from* the inner tuberosity of the os calcis, the internal annular ligament, plantar fascia, and intermuscular septum,—*into* the inner side of the base of the 1st phalanx of the great toe. *Action,* to abduct the great toe. *Nerve,* internal plantar.

Flexor Brevis Digitorum,[f] *from* the inner tuberosity of the os calcis, the plantar fascia and intermuscular septa,—*into* the sides of the 2d phalanges of the lesser toes by 4 tendons which are perforated for the long flexor tendons. *Action,* to flex the lesser toes. *Nerve,* internal plantar.

FIG. 52.



Abductor Minimi Digiti,[h] *from* the outer tuberosity and under surface of the os calcis, the plantar fascia and the intermuscular septum,—*into* the base of the 1st phalanx of the little toe with the tendon of its short flexor. *Action,* to abduct the little toe. *Nerve,* external plantar.

Flexor Accessorius, by 2 heads, *from* the os calcis and the calcaneo-scaphoid and long plantar ligaments,—*into* the tendon of the flexor longus digitorum. *Action,* accessory flexor of the toes. *Nerve,* external plantar.

Lumbricales[g] (4), *from* the long flexor tendons —*into* the inner side of the second phalanges of the lesser toes. *Action,* accessory flexors. *Nerves,* internal plantar to the two internal, external plantar to the others.

Flexor Brevis Pollicis,[c] *from* the cuboid and external cuneiform bones, and the prolonged tendon of the tibialis posticus,—*into* both sides of the base of the 1st phalanx of the great toe, by 2 portions, of which one blends with the abductor pollicis, the other with the adductor pollicis. *Action*, to flex the great toe. *Nerve*, internal plantar.

Adductor Pollicis, *from* the tarsal ends of the three middle metatarsal bones, and the sheath of the tendon of the peroneus longus,—*into* the base of the 1st phalanx of the great toe, externally. *Action*, to adduct the great toe. *Nerve*, external plantar.

Flexor Brevis Minimi Digiti,[i] *from* the base of the 5th metatarsal bone and the sheath of the tendon of the peroneus longus,—*into* the base of the 1st phalanx of the little toe externally. *Action*, to flex the little toe. *Nerve*, external plantar.

Transversus Pedis, *from* the under surface of the head of the 5th metatarsal bone, and the transverse ligament of the metatarsus,—*into* the outer side of the 1st phalanx of the great toe, blending with the tendon of the adductor pollicis. *Action*, to adduct the great toe. *Nerve*, external plantar.

Dorsal Interossei (4), each by two heads *from* the adjacent sides of two metatarsal bones,—*into* the base of the 1st phalanx of the corresponding toe. *Action*, to abduct the toes. *Nerve*, external plantar.

Plantar Interossei[j] (3), *from* the shafts of the 3d, 4th, and 5th metatarsal bones,—*into* the bases of the 1st phalanges of the same toes. *Action*, to adduct the toes towards the median line. *Nerve*, external plantar.

THE HEART.

What is the Pericardium? It is a conical membranous closed sac, containing the heart and the roots of the great vessels. It lies behind the sternum and between the pleuræ, its apex upwards, its base below and attached to the central tendon of the diaphragm. It is composed of an outer fibrous coat, and an inner serous one; the latter consisting of two portions, a parietal layer, lining the inner surface of the fibrous coat, and a visceral layer, which is reflected over the heart and vessels. The serous portion secretes a thin fluid, about 1 drachm in quantity normally, for the lubrication of its surfaces. The fibrous coat is prolonged on the outer surfaces of the great vessels, except the inferior vena cava, and becomes continuous with the deep layer of the cervical fascia.

Describe the Endocardium. It is a serous membrane which lines the inner surface of the heart, forming by its reduplications the cardiac, aortic, and pulmonary valves, and continuous with the lining membrane of the great vessels.

Nutrient Branch, enters the nutrient canal.

Inferior Profunda, to the elbow-joint anastomosis.

Anastomotica Magna, anastomoses with the posterior articular, inferior profunda, anterior and posterior ulnar recurrent.

Muscular Branches, to the muscles in the course of the artery.

Describe the Radial. It extends from the bifurcation of the brachial to the deep palmar arch, and gives off the following branches respectively, in the forearm, the wrist, and the hand, viz.—

Radial Recurrent.
Muscular.
Superficialis Volæ.
Anterior Carpal.

Posterior Carpal.
Metacarpal.
Dorsalis Pollicis.
Dorsalis Indicis.

Princeps Pollicis.
Radialis Indicis.
Perforantes.
Interosseæ.

Name the Branches of the Ulnar. It extends from the division of the brachial to the superficial palmar arch. It has 8 branches, viz.—

Anterior Ulnar Recurrent.
Posterior Ulnar Recurrent.
Interosseous { *Anterior.* *Posterior.*

Muscular.
Anterior Carpal.
Posterior Carpal.

Deep or Communicating Branch.
Digital.

Describe the Palmar Arches. *The Superficial Palmar Arch* is that part of the ulna artery lying in the palm of the hand, and anastomosing with the superficialis volæ from the radial, and a branch from the radialis indicis, at the root of the thumb. It gives off 4 branches, the digital, to the sides of the fingers, except the inside of the index finger, which is supplied by the radialis indicis. *The Deep Palmar Arch* is formed by the palmar portion of the radial artery anastomosing with the deep or communicating branch of the ulna. It gives off the radialis indicis, palmar interosseæ, perforating and recurrent branches.

Describe the Thoracic Aorta. It begins on the left of the spine, at the lower border of the 3d dorsal vertebra, and ends at the aortic opening in the diaphragm directly in front of the last dorsal vertebra. Its branches are as follows :—

Pericardiac Branches, irregular in number and origin.

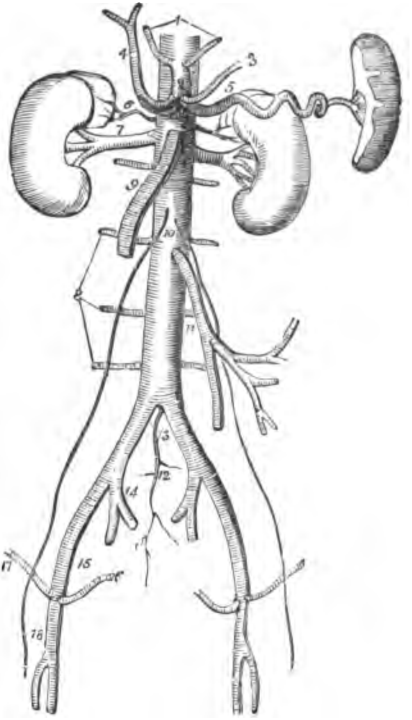
Bronchial, also vary in number and origin; generally one on the right side and two on the left. They nourish the lungs.

Œsophageal, 4 or 5, anastomose on the œsophagus with branches of the inferior thyroid, phrenic, and gastric.

Posterior Mediastinal, numerous small vessels.

Intercostals, usually 10 on each side, each dividing into an anterior and a posterior branch. The *anterior* divides again into two along the adjacent borders of the ribs, supplying the intercostal muscles and anastomosing with branches of the internal mammary and axillary. The *posterior* divides into a spinal branch going to the vertebræ and the spinal cord, and a muscular to the muscles of the back.

FIG. 58.



Describe the Abdominal Aorta. It begins where the thoracic ends, and terminates at the 4th lumbar vertebra in the common iliacs. Its branches are as follows:—

CŒLIAC AXIS,[2] arises opposite the margin of the diaphragm, runs forwards for half an inch and divides into the Gastric, Hepatic, and Splenic arteries, occasionally giving off one of the phrenics.

Gastric,[3] supplies the stomach along its lesser curvature, anastomosing with the aortic, œsophageal, splenic, and hepatic branches.

Hepatic,[4] divides in the transverse fissure of the liver into the right and left branches, to the lobes of that organ; also the—

Pyloric.
Cystic.
Gastro-duodenalis { Gastro-epiploica Dextra.
Pancreatico-duodenalis.

Splenic,[5] the largest branch of the cœliac axis, passes by a very tortuous course to the spleen, giving off the following:—

Pancreaticæ Parvæ.
Pancreatica Magna.
Gastric (vasa brevia).
Gastro-epiploica Sinistra.

Phrenic,[1] one on each side, but usually only one arises from the aorta, the other springing from either the cœliac axis or the renal artery. They go to the under surface of the diaphragm.

Superior Mesenteric,[9] supplies the small intestine, cæcum, ascending and transverse colon. Arising about one-fourth inch below the cœliac axis, it arches forwards, downwards, and to the left, giving off—

Inferior Pancreatico-duodenal. Ileo-colic.
Vasa Intestini Tenuis. Colica Dextra and Media.

Inferior Mesenteric,[11] supplies the descending colon, sigmoid flexure, and most of the rectum, giving off the following branches:—

Colica Sinistra. Sigmoid. Superior Hemorrhoidal.

Supra-renal,[6] arise one on each side, opposite the origin of the superior mesenteric, passing to the supra-renal capsules.

Renal,[7] one from each side, just below the preceding, pass to the kidney, at the hilum having the middle place between the ureter behind and the renal vein in front. U. A. V. (you 'ave!)

Spermatic,[10] one on each side, in the male through the inguinal canal to the testes; in the female to the ovaries, uterus, and the skin of the labia and groins.

Lumbar,[8] usually 4 on each side, analogous to the intercostals. They each divide into two branches, the—

Dorsal, giving off a spinal branch. Abdominal.

Middle Sacral,[12] arises just at the bifurcation of the aorta; it descends along the sacrum and coccyx, giving off numerous branches.

Describe the Common Iliac Arteries. They extend from the bifurcation of the aorta at the 4th lumbar vertebra to near the lumbo-sacral articulation, where they each divide into the external[15] and internal iliac.[14] They are about 2 inches in length, the right being a little longer than the left one, and each is crossed by the ureter, just before its bifurcation.

Describe the Internal Iliac.[14] It is about 1½ inches long, and extends from the lumbo-sacral articulation to the great sacro-sciatic notch, where it divides into an anterior and a posterior trunk. From the anterior trunk are given off from above downwards, the—

Superior Vesical, the remaining pervious part of the fœtal hypogastric artery. It sends branches to the vas deferens and the ureter; and one, the *Middle Vesical*, to the base of the bladder.

Obturator, through the canal in the obturator foramen to the thigh, where it divides into an internal and external branch. Within the pelvis it gives off an iliac, vesical, and a pubic branch. In one out of 3½ cases this artery arises from the epigastric.

Inferior Vesical, to the bladder, prostate gland, and vesiculæ seminales. In the female this artery is called the *Vaginal*.

Middle Hemorrhoidal, to the rectum.

Uterine, in the female, anastomosing with the ovarian.

Internal Pudic, the smaller of the terminal branches of the anterior trunk, supplies the external generative organs. Its branches in the pelvis are numerous and small, in the perineum they are—

Inferior Hemorrhoidal.
Superficial Perineal.
Transverse Perineal.
Artery of the Bulb.
Artery of the Corpus Cavernosum.
Dorsal Artery of the Penis.

Sciatic, the other terminal branch, supplies the muscles on the back of the pelvis. Its branches are as follows:—

Muscular Branches.
Hemorrhoidal Branches.
Vesical Branches.
Coccygeal.
Inferior Gluteal.
Comes Nervi Ischiadici.
Muscular, external to the pelvis.
Articular Branches.

THE POSTERIOR TRUNK gives off the following:—

Ilio-lumbar, dividing into lumbar and iliac branches.

Lateral Sacral, superior and inferior on each side.

Gluteal, the continuation of the posterior trunk, divides into a superficial and a deep branch, to the glutei muscles, the skin over the sacrum, and the hip-joint. Before dividing it gives a nutrient branch to the ilium, and some muscular branches.

Describe the External Iliac. It extends to beneath the centre of Poupart's ligament, where it enters the thigh and becomes the *Femoral Artery*, lying between the femoral vein on the inside and the anterior crural nerve on the outside—V.A.N. Its branches are, small muscular and glandular, and—

Epigastric, which usually arises a few lines above Poupart's ligament, passes between the peritoneum and the transversalis fascia, to the sheath of the rectus which it perforates, and ascends behind that muscle, to anastomose by numerous branches with the terminal branches of the internal mammary and inferior intercostal. It gives off—

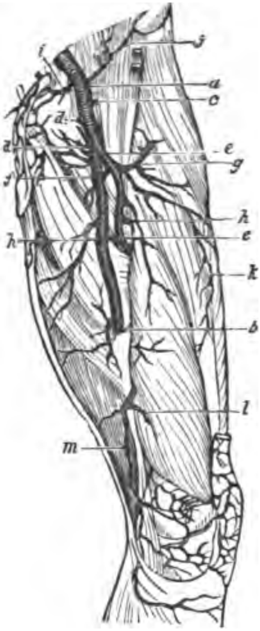
Cremasteric.
Pubic.
Muscular Branches.

Circumflex Iliac, arises opposite to the epigastric, passes along the crest of the ilium to anastomose with the ilio-lumbar, gluteal, lumbar, and epigastric arteries.

Describe the Femoral Artery. It extends from Poupart's ligament to the pening in the adductor magnus, where it becomes the popliteal artery. Its ourse corresponds to a line drawn from a point midway between the anterior uperior spine of the ilium and the symphysis pubis, to the inner side of the nner condyle of the femur. It lies in a strong fibrous sheath with the femoral ein, but divided from the latter by a fibrous partition. It bisects Scarpa's iangle in the upper part of its course, where it is superficial, and rests on the nner margin of the psoas, which separates it from the capsule of the hip-joint. s branches are as follows:—

Superficial Epigastric,^{c} to the superficial fascia of the abdomen.

FIG. 59.



Superficial Circumflex Iliac,^{j} to the skin over the iliac crest.

Superficial External Pudic,^{d} to the integument of the lower abdomen, penis, and scrotum.

Deep External Pudic,^{d} to the skin of the scrotum and perineum.

Profunda Femoris,^{e} arises posteriorly about 1 or 2 inches below Poupart's ligament, and descends to the lower third of the back of the thigh, giving off the following branches:—

Ext. Circumflex.^{g} Int. Circumflex.^{f}
3 Perforating.^{h}

Muscular Branches,^{k} to the sartorius and vastus internus.

Anastomotica Magna, arises from the femoral in Hunter's canal, and divides into a superficial and deep branch, the latter anastomosing around the knee-joint with the superior external and internal articular arteries, and the recurrent tibial.

Describe the Popliteal Artery. It extends from the opening in the adductor magnus to the lower border of the popliteus muscle, where, having passed behind the knee-joint, it divides into the anterior and posterior tibial arteries. Its branches are as follows:—

Superior Muscular Branches.
Inferior Muscular, or Sural.
Cutaneous Branches.
Superior External Articular.
Superior Internal Articular.^{l}
Azygos Articular.
Inferior External Articular.
Inferior Internal Articular.

These are distributed around the knee-joint in a free anastomosis.

The azygos branch perforates the posterior ligament of the joint to reach the internal ligaments and the synovial membrane.

Describe the Anterior Tibial Artery. It extends from the bifurcation of the popliteal to the front of the ankle-joint, where it becomes the *Dorsalis Pedis.* It passes between the two heads of the tibialis posticus, over the upper edge of the interosseus membrane and along its anterior surface, resting on the tibia for its lower one-third. It is accompanied by the anterior tibial nerve close to it externally, and is crossed below by the tendon of the extensor proprius pollicis. Its branches are—

Recurrent Tibial. *Muscular.* *External and Internal Malleolar.*

Describe the Dorsalis Pedis Artery. It is the continuation of the anterior tibial, extending from the front of the ankle-joint to the 1st interosseous space, where it terminates in the *Dorsalis Hallucis* and the *Communicating.* The anterior tibial nerve lies close to its outer side. Its branches are as follows:—

Tarsea, passing outwards along the tarsus.

Metatarsea, giving off 3 interosseæ, and they 7 digital.

Dorsalis Hallucis, to the great toe and the inner side of the second toe by its 3 digital branches.

Communicating, which dips down into the sole of the foot in the 1st interosseous space of the metatarsus, to inosculate with the external plantar; and gives off 2 digital branches to the plantar surface of the great and second toes.

Describe the Posterior Tibial Artery. It is a large vessel, extending from the bifurcation of the popliteal along the back of the tibia to the fossa below the inner malleolus, where it divides into the *Internal* and *External Plantar.* The posterior tibial nerve crosses it a short way below its origin and then lies close to its outer side for the rest of its course. Its branches are as follows:—

Peroneal, along the fibular side, giving off the anterior peroneal, muscular branches, and the nutrient artery of the fibula.

Nutrient of the Tibia, the largest nutrient artery of bone.

Muscular Branches, to the posterior muscles of the leg.

Communicating, a branch to the peroneal artery.

Internal Calcanean Branches, to the heel and sole of the foot.

Describe the Internal Plantar. This artery is the smallest of the terminating branches of the posterior tibial, and passes along the inner side of the foot and great toe.

Describe the External Plantar Artery. It sweeps across the plantar aspect of the foot in a curve, the convexity of which is directed outwards and forwards; and at the interval between the bases of the 1st and 2d metatarsal bones it inosculates with the communicating branch from the dorsalis pedis, forming the *Plantar Arch,* or the *Stirrup Anastomosis.* It gives off numerous muscular branches, and the—

Posterior Perforating, 3 small branches passing through the 3 outer interosseous spaces.

Digital, 4 branches supplying the sides of the 3 outer toes and the outer side of the 2d toe; its inner side, together with the great toe, being supplied by the *Digital Branches* of the *Dorsalis Pedis Communicating.*

Describe the Pulmonary Artery. It alone of the arteries carries venous blood, which it conveys from the right side of the heart to the lungs. It is only about 2 inches long, and nearly all within the pericardium; arising from the right ventricle in front of the ascending aorta, passing upwards and backwards to the under surface of the arch of the aorta, where it bifurcates, and is connected to the aorta by a fibrous cord, the remains of the ductus arteriosus of the fœtus. Its terminal branches are the—

Right and Left Pulmonary Arteries, the latter being the shorter of the two; pass horizontally outwards to the roots of their respective lungs, where each divides into two branches, which again and again subdivide to ramify throughout the lung tissue and end in the capillaries of those organs.

ARTERIAL ANASTOMOSES.

Describe the Anastomosis around the Shoulder-joint. It is formed by the following 8 arteries, viz.—

Posterior Scapular, br. of transv. colli.
Subscapular, br. of axillary.
Dorsalis Scapulæ, br. of subscapular.
Infraspinous, br. of dorsalis scapulæ.
Suprascapular, br. of thyroid axis.
Ant. Circumflex, br. of axillary.
Post. Circumflex, br. of axillary.
Acromial, br. of acromio-thoracic.

What Arteries Anastomose around the Elbow-joint? The—

Superior Profunda, br. of brachial.
Inferior Profunda, br. of brachial.
Anastomotica Magna, br. of brachial.
Posterior Articular, br. of superior profunda.
Radial Recurrent, br. of radial.
Recurrent Interosseous, br. of posterior interosseous.
Anterior Ulnar Recurrent, br. of ulnar.
Posterior Ulnar Recurrent, br. of ulnar.

What Arteries Anastomose around the Hip-joint? They are the

Gluteal, *Ilio-lumbar*, and *Circumflex Iliac*, with the *External Circumflex.*
Obturator and *Sciatic*, with the *Internal Circumflex.*
Comes Nervi Ischiadici, with the *Perforating* branches of the *Profunda.*

Name the Arteries Anastomosing around the Knee-joint. The—

Descending, br. of ext. circumflex.
Anastomotica Magna, br. of femoral.
Inferior Perforating, br. of profunda.
Superior Ext. Articular, br. of popliteal.
Sup. Int. Articular, br. of popliteal.
Inf. Ext. Articular, br. of popliteal.
Inf. Int. Articular, br. of popliteal.
Recurrent Tibial, br. of anterior tibial

How is the Collateral Circulation established after Ligature of th Carotid or Subclavian? By the following anastomoses, viz.—

Superior Thyroid, br. of external carotid, with the *Inferior Thyroid*, br. o the thyroid axis, from the subclavian.

Arteria Princeps Cervicis, br. of occipital, from the external carotid, with the *Vertebral*, br. of subclavian, and the *Profunda Cervicis*, br. of the superior intercostal, from the subclavian.

What is the Longest Anastomosis in the Body? That between the subclavian and the external iliac by the anastomosis of the *Superior Epigastric*, br. of the internal mammary, with the *Deep Epigastric*, br. of the external iliac.

[The circle of Willis has been described on page 106; the palmar and plantar arches on pages 108 and 113 respectively; and the anastomosis on the membrana tympani on page 105.]

THE VEINS.

What are the Veins? Vessels carrying blood towards the heart. Their walls are composed of 3 coats, an internal, serous; a middle, muscular; and an external, fibrous. They all carry carbonized or venous blood, except the pulmonary veins, which bring oxygenated blood to the left side of the heart. The deep veins accompany the arteries, generally in the same sheath, and are given the same names. The secondary arteries, as the radial, ulnar, brachial, etc., have each two veins, called *Venæ Comites*. The superficial veins are usually unaccompanied by arteries, and lie, as a rule, between the layers of the superficial fascia, terminating in the deep veins. Many veins are so irregular in their origin that they cannot be accurately described; they all anastomose with each other much more freely than do the arteries.

What are Sinuses? They are venous channels, differing from veins in structure, but answering the same purpose. Those of the cranium are formed by the separation of the layers of the dura mater.

How are the Veins divided? Into the *Pulmonary*, *Systemic*, and *Portal Systems*; the latter being an appendage of the systemic, its capillaries ramifying in the liver.

What Veins have no Valves? The venæ cavæ, hepatic, portal, renal, uterine, ovarian, cerebral, spinal, pulmonary, umbilical, and the very small veins.

Name the principal Veins of the Head and Neck. They are the—

(1.) Exterior veins.

Facial.
Temporal.
Internal Maxillary.
Temporo-maxillary.
Posterior Auricular.
Occipital.

(2.) Veins of the diploë and cranium.

Veins of the Diploë.
Cerebral and Cerebellar.
Superior Longitudinal Sinus.
Inferior Longitudinal Sinus.
Straight Sinus.
Circular Sinus.
Transverse Sinus.
Cavernous Sinus.
Occipital Sinus.
Superior Petrosal Sinus.
Inferior Petrosal Sinus.
Lateral Sinus.

(3.) Veins of the neck draining the above-named.

External Jugular,[6] terminating in the subclavian vein.[4]

Posterior External Jugular, opens into the external jugular.

Anterior Jugular,[7] enters the subclavian vein near the external jugular.

Internal Jugular,[5] formed by the junction of the two last-named sinuses at the jugular foramen, and uniting with the subclavian vein to form the innominate, at the root of the neck. In its course it receives the facial, lingual, pharyngeal, superior and middle thyroid veins, and the occipital.

Vertebral, descends the foramina in the transverse processes of the cervical vertebræ, and empties into the innominate vein.

Name the Veins of the Upper Extremity. They are in two sets, superficial and deep. The deep follow the arteries, generally as venæ comites, beginning in the hand as *Digital, Interosseous,* and *Palmar* veins, they unite in the *Deep Radial* and *Ulnar* which unite to form the *Venæ Comites* of the brachial artery at the bend of the elbow. The superficial veins lie in the superficial fascia; they are as follows:—

Radial................................	*Median Cephalic.*	*Cephalic.*	AXILLARY VEIN.
Median................................			
Anterior and Posterior Ulnar......	*Median Basilic.*	*Basilic.*	

Name the principal Veins of the Thorax. They are as follows, viz.—

Internal Mammary.
Inferior Thyroid.
Intercostal.
Bronchial.
Mediastinal.
Pericardiac.
Right Azygos (major).
Left Lower Azygos (minor).
Left Upper Azygos (minimus).

What are the Azygos Veins? They supply the place of the venæ cavæ in the region where these trunks are deficient, being connected with the heart. *The Right Azygos*[17] begins by a branch from the right lumbar veins usually, passes through the aortic opening in the diaphragm, and ends in the superior vena cava, having drained 9 or 10 right lower intercostals, the vena azygos minor, the right bronchial, œsophageal, mediastinal, and vertebral veins. *The Left Lower Azygos*[18] begins by a branch from the left lumbar or renal, passes the left crus of the diaphragm, crosses the vertebral column and ends in the right azygos, having drained 4 or 5 lower intercostals. *The Left Upper Azygos* drains 2 or 3 left intercostals and empties into either of the other two. It is often wanting, its place being filled by the left superior intercostal vein.[21]

Name the Spinal Veins. They may be arranged into 4 sets, as follows, viz.—

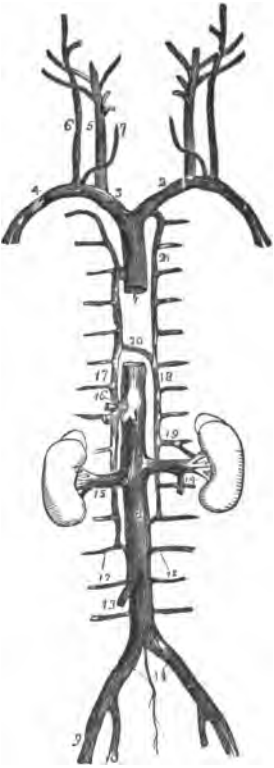
Medulli-spinal, the veins of the spinal cord, which lie in plexus form between the pia mater and arachnoid. They unite into 2 or 3 small trunks near the base of the skull, which terminate in the inferior cerebellar veins or in the petrosal sinuses.

Venæ Basis Vertebrarum, empty into the anterior longitudinal.

Longitudinal, in two plexuses, anterior and posterior, running the whole length of the spinal canal. The posterior join the dorsi-spinal veins, the anterior empty into the vertebral, intercostal, lumbar, and sacral veins in their various regions.

Dorsi-spinal, form a plexus around the spines, processes, and laminæ of all the vertebræ. They empty into the vertebral, intercostal, lumbar, and sacral veins in their respective regions.

FIG. 60.



Describe the Subclavian Vein. It is the ontinuation of the axillary, extending from he outer margin of the 1st rib to the sterno-lavicular articulation, where it unites with the nternal jugular to form the innominate vein. t the angle of junction enters the thoracic uct on the left side of the body and the right mphatic duct on the right side. In its course receives the external and anterior jugular eins and a branch from the cephalic.

Describe the Venæ Innominatæ. The wo innominate veins are each formed by the nion of the subclavian and internal jugular, nd unite below the 1st costal cartilage to rm the superior vena cava. *The Right Inominate*[3] is about 1½ inch long, and receives, esides its constituent branches, the right in-rnal mammary, right inferior thyroid, and ght superior intercostal veins. *The Left Inominate*[2] is about 3 inches long, and in its urse it receives the vertebral, inferior thyid, internal mammary, and superior interstal veins of the left side.

Describe the Superior Vena Cava.[1] It is short trunk about 2½ or 3 inches in length, formed by the union of the venæ nominatæ, and receives all the blood from the upper half of the body, termiting in the right auricle of the heart. It is half covered by the pericardium, d receives the vena azygos major and small pericardiac and mediastinal veins.

Name the Principal Veins of the Lower Extremity. They are in two ts, superficial and deep. The deep are the *Venæ Comites* of the anterior and posterior tibial and peroneal arteries, which collect the blood from the deep parts of the foot and leg, and unite in the—

Popliteal, which becomes the *Femoral*, and it the *External Iliac* in the same manner as the respectively-named arteries.

The superficial veins of the lower extremity are the—

Internal or Long Saphenous, on the inside of the leg and thigh, enters the femoral at the saphenous opening 1½ inch below Poupart's ligament. I its course it receives the following:—

Cutaneous Branches.
Superficial Epigastric.
Pudic.
Superficial Circumflex Iliac.
Communicating Branches.

External or Short Saphenous, formed by branches from the dorsum and oute side of the foot, it ascends behind the outer malleolus, up the middle o the back of the leg, and empties into the popliteal vein.

Describe the Internal Iliac Vein.[10] It is formed by the venæ comites of the branches of the internal iliac artery, except the umbilical. It terminates wit the external iliac, at the sacro-iliac articulation, to form the common iliac vei It receives the following veins:—

Gluteal.
Sciatic.
Internal Pudic.
Obturator.
Hemorrhoidal and Vesico-prostatic, in the male.
Uterine and Vag nal Plexuses, i the female.

Describe the Common Iliac Veins.[11] They are each formed by the unio of the two iliac veins as above described, and unite between the 4th and 5 lumbar vertebræ to form the inferior vena cava, the right common iliac bei the shortest of the two. Each receives the *Ilio-lumbar*, sometimes the *Late* *Sacral*, and the left one in addition the *Middle Sacral Vein*, which someti ends in the vena cava.

Describe the Inferior Vena Cava.[8] It extends from the junction of the tw common iliac veins, passing along the front of the spine, through the tendino centre of the diaphragm, to its termination in the right auricle of the hea It receives the following veins:—

Lumbar.[12]
Right Spermatic.[13]
Renal.[15]
Supra-renal.
Phrenic.
Hepatic.[16]

Describe the Portal System. The portal system is formed by the *Super and Inferior Mesenteric, Splenic, and Gastric Veins*, which collect the blo from the digestive viscera, and by their union behind the head of the p creas form the *Portal Vein*, which enters the transverse fissure of the liv where it divides into 2 branches, and these again subdivide, ramifying throug out that organ, therein receiving blood also from the branches of the hep artery. Its contents enter the inferior vena cava by the hepatic vein. T portal vein is about 4 inches long, receives the *Gastric and Cystic Veins*, and formed by the union of the superior mesenteric and splenic veins, the inferior mesenteric joining the splenic, which also receives one of the gastric, the other emptying into the portal.

Name the Cardiac Veins. They return the blood from the tissue of the heart into the right auricle. They are the—

Great Cardiac Vein.	*Anterior Cardiac Veins.*
Posterior Cardiac Vein.	*Vena Thebesii.*

Coronary Sinus, is a dilatation of the great cardiac vein, receiving the posterior cardiac and an oblique vein from the left auricle.

Describe the Pulmonary Veins. They alone of the veins carry arterial blood, beginning in the capillaries of the lungs, forming a single trunk for each lobule, which, uniting into a single trunk for each lobe, form two main trunks from each lung which open separately into the left auricle. Sometimes the 3 lobe-trunks of the right lung remain separate to their termination in the auricle, and not unfrequently a common opening serves for the 2 left pulmonary veins.

THE ABSORBENTS.

What are the Lymphatics? They are very delicate, transparent vessels, formed of three coats like arteries and veins, found in nearly every part of the body, except the brain, spinal cord, eyeball, cartilage, tendons, membranes of the ovum, placenta, umbilical cord, nails, cuticle, hair, and bone. They are nourished by nutrient vessels, and have valves, but no nerves, so far as known. They convey *lymph* to the blood.

What are the Lacteals? They are the lymphatics of the small intestine, conveying the *chyle* therefrom into the blood.

What are the Lymphatic Glands? Small solid bodies placed in the course of the absorbent vessels, and found chiefly in the mesentery, along the great blood-vessels, in the mediastina, axilla, neck, front of the elbow, groin, and popliteal space. The lymphatics and lacteals before entering these glands break up into smaller branches, the *afferent vessels*, which form a plexus in the gland, and pass out as *efferent vessels* to unite again in one trunk. They also contain spheroidal bodies about $\frac{1}{3000}$ inch in diameter. These glands are named after the regions in which they are situated, as the axillary, inguinal, mesenteric, etc.

Describe the Thoracic Duct. It is the main channel for the lymph and chyle from the whole body except the right arm and lung, right side of the head, heart, neck, and thorax, and the convex surface of the liver. It begins in the *Receptaculum Chyli*, in front of the 2d lumbar vertebra, passes through the aortic opening in the diaphragm, and at the upper border of the 7th cervical vertebra it curves forwards, outwards, and downwards, terminating in the left subclavian vein at its junction with the internal jugular.

Describe the Right Lymphatic Duct. It is about an inch long, terminating in the right subclavian vein at its union with the internal jugular, and draining the lymphatics of those parts which are not connected with the thoracic duct.

THE NERVOUS SYSTEM.

How is the Nervous System divided? Into the *Cerebro-spinal*, or nervous system of animal life; and the *Sympathetic*, or nervous system of organic life.

What is the Structure of the Nervous tissue? It is formed of two substances essentially different from each other, the *White* or fibrous, and the *Gray* or vesicular matter. Chemically these contain phosphorized fat, albumen, and water. A third form, the *Gelatinous*, is yet a subject of disagreement among authorities.

Describe the White Nerve-matter. It is composed of a number of tubes, each consisting of a central *Axis-cylinder*, surrounded by the *White Substance of Schwann*, and this again enclosed in the tubular membrane, or *Nerve-sheath.* The whole arrangement is precisely analogous to that of a submarine telegraphic cable. A bundle of such tubes is invested by a covering, the *Neurilemma*, or perineurium, and is called *a Nerve*, and is nourished by a minute capillary system of blood-vessels.

How do Nerves terminate? Sensory nerves end peripherally as plexuses in their end-organs in the tissues. Motor nerves end peripherally in muscles as plexuses, or plates. Their central termination is not yet understood.

Of what does the Cerebro-spinal system consist? Of the brain, the spinal cord, the ganglia, and the cranial and spinal nerves.

THE BRAIN.

What are the Membranes of the Brain? The dura mater, the arachnoid, and the pia mater.

Describe the Dura Mater. It is a dense fibrous membrane lining the interior of the skull, and forming the internal periosteum of the cranial bones. It is continuous with the dura mater of the spinal cord, and is attached to many parts of the base of the skull. It presents the following for examination:—

Falx Cerebri, an arched process sent into the longitudinal fissure of the brain, contains in its upper and lower margins the superior and inferior longitudinal sinuses.

Tentorium Cerebelli, a lamina of dura mater supporting the posterior lobes of the brain, and covering the upper surface of the cerebellum. It incloses the lateral and superior petrosal sinuses.

Falx Cerebelli, projects between the lateral lobes of the cerebellum, from the tentorium to the foramen magnum.

Pacchionian Bodies, clusters of white granulations situated on the outer and inner surfaces of the dura mater, in the superior longitudinal sinus, and on the pia mater, found only after the 7th year, and of unknown function.

Describe the Arachnoid. It is the serous sac which forms the middle membrane, having a visceral and a parietal layer, the latter being reflected over the interior surface of the dura mater. *The Anterior Sub-arachnoid Space* is the interval between it and the pia mater of the brain at the base, where it is extended across between the two middle lobes. *The Posterior Sub-arachnoid Space* is a similar interval between the hemispheres of the brain and the medulla oblongata. These spaces communicate together across the crura cerebri; and also with the general ventricular cavity, by an opening in the lower boundary of the 4th ventricle; and contain the cerebro-spinal fluid which forms a water-bed for the nervous centres. The sac of the arachnoid also contains a serous fluid in small quantity.

What is the Pia Mater? It is the vascular membrane, being supplied by the branches of the internal carotid and vertebral arteries. It covers the surface of the brain, dipping down into all the sulci, and forms the velum interpositum and choroid plexus of the 4th ventricle; and contains lymphatics and nerves.

How is the Brain divided? Into the cerebrum, cerebellum, pons Varolii, and medulla oblongata. Its average weight in the male adult is 49½ oz., in the female 44 oz., of which the cerebrum is about seven-eighths. The extreme weights in 278 male cases were 65 oz. and 34 oz.,—in 191 female cases, 56 oz. and 31 oz.

Describe the principal Lobes and Fissures of the Cerebrum. Each lateral half of the cerebrum, or hemisphere, has the following 5 lobes and 8 fissures, besides many of less importance.

Frontal Lobe, bounded internally by the longitudinal fissure, below by the fissure of Sylvius, and posteriorly by the fissure of Rolando.

Parietal Lobe, extending down to the fissure of Sylvius, and antero-posteriorly from the fissure of Rolando to the parieto-occipital.

Occipital Lobe, behind the parieto-occipital fissure.

Temporo-sphenoidal Lobe, lying in the middle fossa of the skull, and bounded in front by the fissure of Sylvius.

Central Lobe, or Island of Reil, lies in the fissure of Sylvius, covered by the frontal and temporo-sphenoidal lobes.

Longitudinal Fissure, separating the two hemispheres.

Fissure of Sylvius, at the base of the brain, extending outwards on each side, and dividing into 2 branches, an ascending and a horizontal one. It lodges the middle cerebral artery.

Fissure of Rolando, on the superior surface, extending from the longitudinal fissure about its centre, downwards and forwards towards the fissure of Sylvius, separating the frontal and parietal lobes.

Parieto-occipital Fissure, extends from the longitudinal fissure outwards for about an inch between the parietal and occipital lobes. It is better marked in a longitudinal section of the brain.

Calloso-marginal Fissure, above the gyrus fornicatus on the inner surface of the hemisphere.

Transverse Fissure, between the middle lobe and the crus cerebri, at the base of the brain. It admits the pia mater to the lateral ventricle.

Calcarine Fissure, also seen on the inner surface, extending from the lower end of the parieto-occipital fissure outwards to the posterior border of the occipital lobe.

First Temporo-sphenoidal Fissure, below the fissure of Sylvius, on the lateral surface of the brain.

Name the principal Convolutions of the Cerebrum. The superior and inner surfaces of each hemisphere are formed of convolutions (*gyri*) with intervening furrows (*sulci*) of various depths, both gyri and sulci being formed of gray matter thus arranged to enable it to present a great extent of surface. The convolutions are not uniform in all brains as to arrangement, nor are they symmetrical in the two hemispheres. The most constant are the following:—

Gyrus Fornicatus, the convolution over the corpus callosum, seen on the inner surface, arching from before backwards.

Convolution of the Longitudinal Fissure, along the edge of that fissure on the superior surface, curving over the front and back of each hemisphere, to the base of the brain.

Ascending Frontal, lies in front of the fissure of Rolando.

Ascending Parietal, lies behind the fissure of Rolando.

Angular Gyrus, or Pli Courbe, around the posterior end of the first temporo-sphenoidal fissure.

Many other convolutions are named by writers on the localization of cerebral functions, such as the temporo-sphenoidal, occipital, supra-marginal convolutions, etc. Their names will be found sufficiently explanatory of their several locations. The *Cuneus, Precuneus,* and *Paracentral Lobule* are names given to the regions between the calcarine, parieto-occipital, and calloso-marginal issures, the last-named locality lying in front of the last-named fissure.

Name the Points in view on the Inferior Surface of the Brain. From efore backwards, excluding the cranial nerves, are the following:—

Longitudinal Fissure, its anterior portion.

Corpus Callosum, the great transverse commissure of the brain.

Lamina Cinerea, a thin, gray layer, beneath the optic tracts.

Fissure of Sylvius, between the anterior and temporo-sphenoidal lobes.

Anterior Perforated Space, for vessels to the corpora striata.

Optic Commissure, formed by the junction of the optic tracts.

Tuber Cinereum, a gray lamina behind the optic commissure, forming part of the floor of the 3d ventricle.

Infundibulum, a hollow process, connecting the pituitary cavity with the 3d ventricle in the fœtus.

Pituitary Body, a vascular bi-lobed body, of glandular structure, projects from the infundibulum into the sella turcica of the sphenoid.

Corpora Albicantia, two round, white eminences, united together; they are the anterior crura of the fornix folded on themselves.

Posterior Perforated Space (*Pons Tarini*), for vessels to the optic thalami.

Crura Cerebri, or cerebral peduncles, connect the cerebrum with the cerebellum, spinal cord, and medulla oblongata; containing the fibres passing to the basal ganglia. They, with the optic tracts, form the boundaries of the *Inter-peduncular Space*.

Pons Varolii, to be described separately. [See page 127.]

What Ganglia are comprised in the Brain? Besides the gray matter of he cerebral hemispheres, of the cerebellum, and of the medulla oblongata, here are the following at the base of the brain:—

Olfactory Bulbs.
Corpora Striata.
Optic Thalami.
Tubercula Quadrigemina.
Tuber Annulare.

Describe the Basal Ganglia. They are as follows, viz.—

lfactory Bulbs are the ganglia of the sense of smell, lie one on each side of the median line, upon the cribriform plate of the ethmoid, and are connected with the hemispheres by the *Olfactory Tracts*.

orpora Striata, the motor ganglia, are situated in the floor of the lateral ventricles, and therefore within the hemispheres. Each corpus striatum has a—

Caudate Nucleus,—the intraventricular part.
Lenticular Nucleus,—the extraventricular part.
Internal Capsule,—divides these two parts.

ptic Thalami, the sensory ganglia, are in the floor of the lateral ventricles, behind the corpora striata. Each thalamus opticus is divided into an anterio tubercle seen in the lateral ventricle, and a posterior tubercle beneath th fornix.

Corpora Quadrigemina, or Optic Lobes (2 nates and 2 testes), lie beneath th posterior lobes, near the union of the cerebrum and cerebellum. They form two single ganglia for vision. [Described under Meso-cephalon.]

Tuber Annulare, a ganglion in the substance of the pons Varolii, the seat o indistinct sensation probably.

Name the Commissures of the Brain. These connecting bands number 1 in all, of which 10 are longitudinal, and 9 transverse in direction, viz.—

Longitudinal Commissures.	*Transverse Commissures.*
Olfactory Tracts.	Anterior Commissure of 3d ventric
Tænia Semicircularis.	Middle Commissure of 3d ventrick
Crura Cerebri.	Posterior Commissure of 3d ventric
Processes e Cerebello ad Testes.	Corpus Callosum.
Peduncles of the Pineal Gland.	Optic Commissure.
Fornix.	Pons Varolii.
Infundibulum.	Fornix, is a transverse commissure a well as a longitudinal one.
Lamina Cinerea.	
Gyrus Fornicatus.	Posterior Medullary Velum.
Fasciculus Unciformis.	Valve of Vieussens.

What are the Ventricles of the Brain? They are 5 cavities, each of whi is situated as follows:—

Two Lateral Ventricles, within the substance of the hemispheres.

Third Ventricle, between the optic thalami, on the base of the brain.

Fourth Ventricle, between the cerebellum and the medulla oblongata.

Fifth Ventricle, between the two lateral, in the septum lucidum.

Ventricle of the Corpus Callosum, so called, is merely the space between th upper surface of that commissure and the margins of the hemisphe above (*labia cerebri*).

The *Foramina of Monroe* connect the two lateral ventricles with the 3d; th *Iter e Tertio ad Quartam Ventriculum*, or aqueduct of Sylvius, connects th 3d with the 4th.

Describe and bound the Lateral Ventricles. They each have 3 *Cornua*, th anterior, middle, and posterior, and are bounded as follows:—

Roof,—the corpus callosum.

Floor,—the corpus striatum, tænia semicircularis or horny band of Tarin optic thalamus, choroid plexus, corpus fimbriatum, and the fornix.

Internally,—the septum lucidum.

Externally, behind and in front,—the brain substance.

What are the parts above-named? Some, as the corpus striatum, optic thalamus, etc., have been described already; the others are—

Corpus Callosum, the great transverse commissure, arching backwards to become continuous with the fornix, reflected below, forming *the Peduncles* at the entrance of the fissure of Sylvius; and marked above by a depression, *the Raphé*, and longitudinal elevations, the *Striæ Longitudinales* or *Nerves of Lancisi.*

Tænia Semicircularis, consists of commissural fibres between the corpus striatum and the optic thalamus.

Choroid Plexus of Veins, is the margin of a fold of pia mater which enters at the transverse fissure, passes up the descending cornu, passes through the foramen of Monroe, and as the *Velum Interpositum* spreads out over the roof of the 3d ventricle.

Corpus Fimbriatum, or *Tænia Hippocampi*, is a white band, the edge of the posterior pillar of the fornix.

Fornix, is a commissure situated beneath the corpus callosum, but continuous with it posteriorly, the *Septum Lucidum* separating them in front. It is of triangular form with the apex in front. Its *Anterior Crura* curve downwards to the base of the brain, are there reflected, forming the *Corpora Albicantia*, and end in the optic thalami. Its *Posterior Crura* pass down the descending horns of the lateral ventricles, as the *Hippocampi Majores. The Lyra* is a series of markings on its under surface.

Septum Lucidum, consists of 2 layers of white and gray matter, lined by epithelium; is placed vertically between the lateral ventricles, from the raphé of the corpus callosum above to the fornix below. The cavity in its centre is the 5th ventricle.

Describe the Cornua of the Lateral Ventricles. The *Anterior Cornu* curves over the anterior end of the corpus striatum into the anterior lobe. The *Posterior Cornu* curves downwards and inwards in the occipital lobe, and contains a smooth eminence, the *Hippocampus Minor*. The *Middle Cornu* descends into the middle lobe to the transverse fissure at the base of the brain, curving backwards, outwards, downwards, forwards, and inwards (B. O. D. F. I.). On its floor are the following:—

Hippocampus Major, the doubled-in surface of the gyrus fornicatus.

Pes Hippocampi, rounded eminences at the end of the hippocampus.

Pes Accessorius, or Eminentia Collateralis, between the hippocampi, at the junction of the middle and posterior cornua.

Corpus Fimbriatum, a continuation of the posterior pillar of the fornix.

Choroid Plexus of Veins, a process of pia mater, already described.

Fascia Dentata, the gray serrated edge of the middle lobe.

Transverse Fissure, at the extremity of the cornu, extending to the median line, between the hippocampus major and the optic thalamus. It opens at the base of the brain between the middle lobe and the crus cerebri, and admits the pia mater to the middle cornu.

Describe and bound the Third Ventricle. It is a mere fissure, situated between the optic thalami in the median line. It communicates with the lateral ventricles above by the foramina of Monroe, and with the 4th ventricle behind by the iter e tertio ad quartam ventriculum. It is crossed by 3 bands, the anterior, middle, and posterior commissures, the middle one being of gray matter, the others of white. In the fœtus its cavity communicates with the 5th ventricle, and through the infundibulum with the cavity of the pituitary body. It is bounded as follows:—

Roof,—the velum interpositum, and above it the fornix.

Floor,—the parts comprised in the interpeduncular space at the base of the brain, viz.—the lamina cinerea, tuber cinereum, infundibulum, corpora albicantia, and posterior perforated space.

Anteriorly,—the anterior crura of the fornix, and the anterior commissure of the ventricle.

Posteriorly,—the posterior commissure, and the iter e tertio, etc.

Laterally,—the optic thalami and the peduncles of the pineal gland.

Describe and bound the Fourth Ventricle. The fourth, or ventricle of the cerebellum, lies between the medulla oblongata and the cerebellum. It is considered by some to be a dilatation of the central canal of the spinal cord, and is enclosed posteriorly by the pia mater; an opening in which admits the entrance and exit of the sub-arachnoid fluid from the sub-arachnoidean space of the brain and spinal cord, and a fold of the pia mater called the *Choroid Plexus*. It also communicates with the 3d ventricle by the *iter e tertio*, etc. Its boundaries are as follows:—

Roof,—the valve of Vieussens, and the cerebellum.

Anteriorly,—the medulla oblongata, and the pons Varolii.

Posteriorly,—the cerebellum.

Laterally,—the processus e cerebello ad testes, the posterior pyramids and the restiform bodies of the medulla oblongata.

Floor,—the posterior median fissure of the medulla, the orifice of the central canal of the cord, the locus ceruleus and tænia violacea (both of blue color), the fasculi teretes (2 spindle-shaped elevations) and eminences of origin of certain nerves.

Describe the Fifth Ventricle. It is situated between the two layers of the septum lucidum, and therefore between the lateral ventricles. Its roof is formed by the corpus callosum, and in the fœtus it communicates with the 3d ventricle by an opening between the pillars of the fornix. It usually contains fluid.

What is the Meso-cephalon? It comprises the parts which connect the erebrum with the cerebellum and the medulla oblongata, and includes the llowing structures, viz.:—

Pons Varolii, a great transverse commissure seen at the base of the brain in front of the medulla. Its fibres connect the hemispheres of the cerebellum with each other and the medulla.

Crura Cerebri, or *Peduncles of the Cerebrum*, extend from the pons to the corpora striata and optic thalami, and consist of the *Peduncular Fibres* which pass from the medulla to the ganglia named, and thence upwards to the gray matter of the hemispheres as the *Corona Radiata*. Each crus contains in its centre a mass of gray matter called the *locus niger*.

Valve of Vieussens, is a thin lamina forming the roof of the iter e tertio ad quartam ventriculum, and stretched between the two processus e cerebello ad testes. Its *Frenulum* is a ridge descending on its upper part from the corpora quadrigemina.

Corpora Quadrigemina, or *Optic Lobes*, are 4 spherical eminences placed together above the valve of Vieussens, and behind the 3d ventricle beneath the posterior border of the corpus callosum. The anterior pair are called the *Nates*, the posterior, the *Testes*, and they are connected with the optic thalami and optic tracts by 4 bands, their *Brachia;* and with the cerebellum by a white cord on each side, the *Processus e Cerebello ad Testes.* They form two ganglia for the centre of vision.

Pineal Gland, is a small conical reddish body situated between the *nates*, on which it rests. Its 4 peduncles connect it with the anterior crura of the fornix, and the optic thalami. It is very vascular, and has a small cavity (said to communicate with the 3d ventricle) which contains a viscid fluid, and some concretions formed of the phosphates of lime, magnesia, and ammonia, etc., called the *Acervulus Cerebri.*

Describe the Medulla Oblongata. This ganglion is the upper enlarged rt of the spinal cord, extending from the upper border of the atlas to the ns Varolii. Its posterior surface forms the floor of the 4th ventricle, its terior surface rests on the basilar groove of the occipital bone. It is divided to two lateral halves by the *Anterior and Posterior Median Fissures*, and conns gray matter scattered throughout it, from which the cranial nerves from 5th to the 12th inclusive arise entirely or in part. In it are supposed to lie centres for the vaso-motor and the cardiac nerves, also centres of respiran, phonation, deglutition, mastication, and expression. On each side it prents the following,—

Anterior Pyramid, formed by the anterior and lateral columns of the spinal cord.

Olivary Body, behind the pyramid, from which it is separated by the groove of the hypoglossal nerve. It contains a capsule of gray matter in its centre, the *Corpus Dentatum*.

Lateral Tract, continuous with the lateral column of the spinal cord, lie behind the olivary body and in front of the restiform.

Restiform Body, the posterior lateral portion of the medulla, also called the *Fasciculus Cuneatus*.

Posterior Pyramid, or Fasciculus Gracilis, the most posterior portion, is formed by the posterior median column of the spinal cord. It diverges from its fellow at the apex of the 4th ventricle and forms the lateral boundary of the *Calamus Scriptorius*.

What is the Cerebellum? It is that portion of the brain situated in the inferior occipital fossæ, beneath the posterior lobes of the cerebrum. It is a oblong flattened ganglion, divided into two lateral hemispheres, and a centr portion, the *Vermiform Process*.

Name the Fissures of the Cerebellum. They are 3 in number,—2 vertical and 1 horizontal, viz.—

Incisura Cerebelli Anterior.
Incisura Cerebelli Posterior.
Great Horizontal Fissure, from which secondary fissures originate.

Name the Points on the surfaces of the Cerebellum. They comprise 1 lobes, 2 commissures, and 3 projections, as follows:—

On the upper surface of each hemisphere,—
Anterior or Square Lobe. *Posterior or Semilunar Lobe.*

On the under surface of each hemisphere, from before backwards,—
Flocculus, Sub-peduncular Lobe, or Pneumogastric Lobule.
Amygdala Lobe, or Tonsil, projects into the 4th ventricle.
Digastric Lobe. *Slender Lobe.* *Posterior Inferior Lobe.*

On the vermiform process are the—

Lobulus Centralis. *Monticulus Cerebelli.* *Commissura Simplex.*	superiorly.	*Pyramid.* *Uvula.* *Commissura Brevis.*	inferiorly.

The Vallecula, or valley of the cerebellum, is the central depression on under surface between the two lateral hemispheres.

Name the Peduncles of the Cerebellum. They are 3 in number on e side, and from below upwards are as follows:—

Processus e Cerebello ad Medullam, to the medulla oblongata.
Processus e Cerebello ad Pontem, connect the hemispheres.
Processus e Cerebello ad Testes, to the cerebrum.

Describe the Gray Matter of the Cerebellum. It occupies the surface the mass in laminated shape, and is traversed by curved furrows, between the laminæ. A vertical section gives an appearance called the *Arbor Vitæ.*

Corpus Dentatum, is a capsule of gray matter in the centre of the white and is open anteriorly. It is sometimes called the ganglion of the cerebellum.

THE SPINAL CORD.

Describe the Spinal Cord. It is that part of the cerebro-spinal axis which is situated in the spinal canal. Its length is about 16 inches, terminating at the lower border of the 1st lumbar vertebra in the *Cauda Equina.* It is cylindrical in general form, with 2 enlargements, one in the cervical region, the other in the lumbar. It is composed of gray and white matter, the gray being inside (instead of outside, as in the cerebrum), and arranged so as to present a crescentic appearance in horizontal section, joined by a transverse commissure, and forming, by their extremities, the *Anterior and Posterior Horns,* from which regions respectively the anterior and posterior roots of the spinal nerves have their apparent origin.

Membranes of the cord are 3, as in the brain,—dura mater, arachnoid, and pia mater. The *Dura Mater* is not adherent to the spinal column, but is connected thereto by fibrous tissue. The *Arachnoid* is arranged as on the brain, its sub-arachnoid space being filled with its fluid, for the protection of the cord. The *Pia Mater* has a fibrous band on each side, the ligamentum denticulatum, connecting it to the dura mater by some 20 serrations.

Fissures, number 8,—the anterior and posterior median, the anterior and posterior lateral on each side, and the two posterior intermediary in the cervical region.

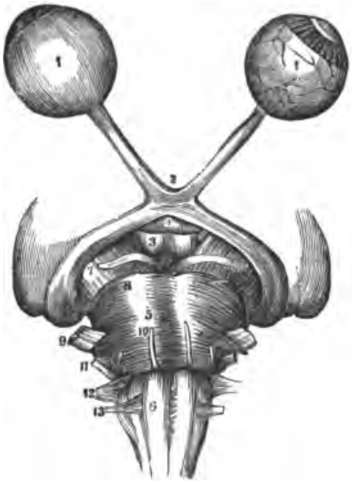
Columns, are 8 in number, 4 on each side of the cord,—an anterior, lateral, posterior, and posterior median. The *Anterior* is continuous with the anterior pyramid of the medulla; the *Lateral,* with the lateral column of the medulla; the *Posterior,* with the restiform body; the *Posterior-median,* with the posterior pyramid.

Central Canal, or *Ventricle of the Cord,* extends through its entire length in the fœtus and in some adults, but is usually closed except for one-half inch below its orifice in the floor of the 4th ventricle.

THE CRANIAL NERVES.

Describe each Cranial Nerve, stating its function, apparent and deep origin, foramen of exit, principal branches and distribution. There are 12 pairs of cranial nerves (9 according to Willis), of which those from the 6th o the 12th inclusive have their deep origin wholly or in part from the floor of he 4th ventricle. They are the—

FIG. 61.



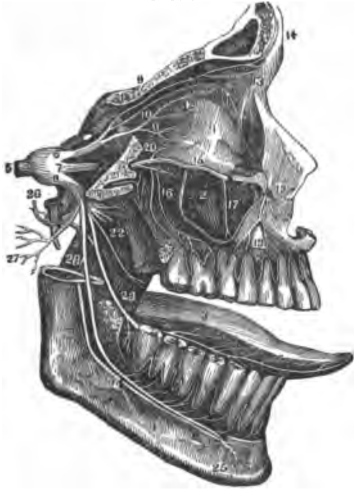
1st, Olfactory, nerve of smell,—*arises* by 2 roots from the anterior cerebral lobe and 1 root from the middle lobe, *deeply* from the optic thalamus, island of Reil, corpus striatum, and anterior commissure; *exit* by 20 branches through the cribriform plate, *to* the Schneiderian membrane. Its bulb is a lobe of the cerebrum.

2d, Optic, nerve of sight,—*arises* from the optic commissure[2] and tracts, *deeply* from the optic thalamus, corpora geniculata, and corpora quadrigemina; *exit* through the optic foramen *to* the retina.

[This nerve and the Optic Tract are more fully described at the end of the volume, under the sub-title, VESSELS AND NERVES OF THE EYE.]

3d, Motor Oculi,[7] motor of the eye, —*arises* from the crus cerebri, *deeply* from the floor of the iter e tertio ad quartum ventriculum; *exit* through the sphenoidal fissure, *to* all the muscles of the orbit except the superior oblique and the external rectus, also to the iris.

FIG. 62.



4th, Patheticus,[8] motor of the eye, —*arises* from the outer side of the crus, *deeply* from the valve of Vieussens; *exit* through the sphenoidal fissure, *to* the superior oblique muscle of the eye.

5th, Trigeminus,[9] nerve of sensation, motion, and taste,—*arises* by two roots,—from the side of the pons Varolii,[5] *deeply* from the pyramidal body (motor root), lateral tract of the medulla, the pons, and cerebellum (sensory root). *Exit* of ophthalmic division by the sphenoidal fissure; of superior maxillary by the foramen rotundum; of inferior max illary division and motor root, by the foramen ovale. The *Gasserian ganglion*,[5] is situated on the sensory root at the origin of its three divisions.

OPHTHALMIC DIVISION,[6] goes to the forehead, eyelids, lachrymal gland, conjunctiva, iris, ciliary ganglion, and the nose. Its branches are—

Frontal.[9]
Lachrymal.[10]
Nasal.[11]

SUPERIOR MAXILLARY DIVISION,[7] goes to the temple, cheek, lower eyelid, nose, lip, upper teeth, and to Meckel's ganglion, thence to the palate. Its branches are the—

Orbital.[20]
Spheno-palatine.
Posterior Dental.[16]
Anterior Dental.[18]
Infraorbital.[15]
- Palpebral.
- Nasal.
- Labial.

INFERIOR MAXILLARY DIVISION,[8] includes the motor branch, and is therefore a nerve of common sensation, motion, and special sense (taste). Its motor filaments go to the muscles of mastication; its sensory to the auditory meatus, to the otic and submaxillary ganglia, the anterior part of the tongue, the cheek, teeth, and the lingualis muscle (sensation). Its branches are the—

Masseteric.
Deep Temporal (*2*).
Buccal.
Pterygoid.
Auriculo-temporal.[26]
Gustatory.[23]
Inferior Dental.[24]
- Mylo-hyoid.[28]
- Incisor.
- Mental.[25]
- Dental.

5th, **Abducens,**[10] motor of the eye,—*arises* from the medulla oblongata, *deeply* from the floor of the 4th ventricle; *exit* by the sphenoidal fissure, *to* the external rectus muscle of the eye.

7th, **Facial, or Portio Dura,**[11] motor of the face, ear, palate, and tongue,—*arises* from the groove between the olivary and restiform bodies of the medulla, *deeply* from the floor of the 4th ventricle. *Exit* by internal auditory meatus, through the aqueductus Fallopii, and stylo-mastoid foramen, *to* the muscles of expression, the tongue, muscles of the ear and palate, etc. It *communicates* with the carotid and meningeal plexuses, the spheno-palatine (Meckel's) and the otic ganglia, the auditory, great auricular, pneumogastric, glosso-pharyngeal, and 5th nerves. Its branches are the—

Great Petrosal, to Meckel's ganglion.
Small Petrosal, to the otic ganglion.
External Petrosal, to the meningeal plexus.
Tympanic, to the muscles of the tympanum.
Chorda Tympani, to the tongue, etc.
Posterior Auricular.
Digastric.
Stylo-hyoid.
Temporo-facial.
Cervico-facial.

th, **Auditory, or Portio Mollis** of the 7th,[11] nerve of hearing,—*arises* just external to the facial, *deeply* from the floor of the 4th ventricle; *exit* by the internal auditory meatus, *to* the internal ear. Its branches are two, the—

Vestibular, to the vestibule.
Cochlear, to the cochlea.

[This nerve is more fully described at the end of the volume, under the sub-title, THE INTERNAL EAR.]

9th, Glosso-pharyngeal,[12] nerve of sensation and taste,—*arises* from the medulla oblongata behind the olivary body, *deeply* from the floor of the 4th ventricle; *exit* by the jugular foramen, *to* the back of the tongue (taste), the middle ear, the tonsils, and pharynx. Branches are—

Tympanic (Jacobson's).	*Pharyngeal.*	*Tonsillar.*
Carotid.	*Muscular.*	*Lingual.*

10th, Pneumogastric, or Par Vagum,[12] the auriculo-laryngo-pharyngo-œsophago-tracheo-pulmono-cardio-gastro-hepatic nerve. A nerve of sensation and motion, probably receiving its motor influence from its *spinal* accessory. It *arises* from the medulla behind the olivary body and below the 9th nerve, *deeply* from the floor of the 4th ventricle; *exit* by the jugular foramen, *to* the parts indicated by the above euphonious appellation, supplying *sensation* to the external ear and larynx, *motion* to the other parts. Its branches are the—

Auricular (Arnold's).	*Recurrent Laryngeal.*	*Œsophageal.*
Pharyngeal.	*Cervical and Thoracic Cardiac.*	*Gastric.*
Superior Laryngeal.	*Ant. and Post. Pulmonary.*	*Hepatic.*

11th, Spinal Accessory[12] (to the pneumogastric),—motor nerve,—*arises* by a double origin (1) from the lateral tract of the medulla, *deeply* from near the floor of the 4th ventricle; (2) from the lateral tract of the cord by several filaments, as low as the 6th cervical nerve, *deeply* from the anterior gray horn of the cord. *Exit* by jugular foramen, its spinal portion having first entered by the foramen magnum, *to* the sterno-cleido-mastoid and trapezius muscles, *communicating* with the pharyngeal and laryngeal nerves by its accessory portion in the same sheath with the pneumogastric; also with the 2d, 3d, 4th, and 5th cervical nerves by its spinal portion. Its branches are indicated by the above-described distribution.

12th, Hypo-glossal,[13] (Nonus or 9th of Willis), motor of the tongue,—*arises* by 10 to 15 filaments from the groove between the pyramidal and olivary bodies of the medulla oblongata, *deeply* from the floor of the 4th ventricle; *exit* by the anterior condyloid foramen, *to* the thyro- and genio-hyoid, the stylo-,hyo-, and genio-hyo-glossus muscles; and by the *descendens noni* branch to the sterno-hyoid, sterno-thyroid, and omo-hyoid muscles. It *communicates* with the pneumogastric, sympathetic, 1st and 2d cervical, and gustatory nerves. Its branches of distribution are the—

Descendens Noni.	*Muscular.*	*Thyro-hyoid.*

What Nerves enter the Cranium before passing out of it? The spinal portion of the Spinal Accessory, and the Nasal branch of the Ophthalmic. The first enters by the foramen magnum, and then leaves by the jugular foramen. The second enters from the orbit by the anterior ethmoidal foramen, and leaves by the nasal slit at the side of the crista galli.

THE SPINAL NERVES.

Describe the Spinal Nerves. There are 31 pairs of spinal nerves, of which the cervical number 8, the dorsal 12, the lumbar 5, the sacral 5, and the coccygeal 1. The 1st cervical escapes above the 1st vertebra, each of the others below the corresponding vertebra through the intervertebral foramina. Each nerve arises by *2 roots*, an anterior motor root, and a posterior sensory one, the latter having a ganglion on it. These unite, and the nerve then divides into *2 branches*, both having motor and sensory fibres. The posterior branches are small and generally unimportant; they supply the muscles and integument of the back. The anterior branches supply the neck, front, and sides of the trunk, and the extremities, uniting in various regions to form plexuses from which important nerve-trunks originate.

How is the Cervical Plexus formed and distributed? It is formed by the anterior branches of the first 4 cervical nerves, and rests on the levator anguli scapulæ and scalenus medius muscles. Its branches (10) comprise 4 superficial to the integument of the head and neck, and the following deep branches, viz.—

Phrenic. *Communicans Noni.* *2 Muscular.* *2 Communicating.*

Describe the Phrenic Nerve. It arises by 3 heads from the 3d, 4th, and 5th cervical, descends across the front of the scalenus anticus, crossing the subclavian and internal mammary arteries in the middle mediastinum, and is distributed to the inferior surface of the diaphragm. It is often called the Internal Respiratory Nerve of Bell. It sends filaments to the pericardium and pleura, and communicates with the plexuses of the sympathetic in the abdomen.

Describe the formation and distribution of the Brachial Plexus. It is formed by the union of the 4 lower cervical nerves and the 1st dorsal. The 5th, 6th, and 7th unite into one trunk externally to the scalenus medius, as also do the 8th cervical and 1st dorsal behind the same muscle. Below the line of the clavicle both these trunks bifurcate; the two adjacent branches unite behind the axillary artery making the *Posterior Cord*, and the remaining 2 form the *Outer* and *Inner Cords*, referred to the artery. Each of these cords bifurcates, but the 2 adjacent branches of the outer and inner cords unite over the artery, to form the *Median Nerve*, leaving 4 other branches, the *Ulnar*, *Musculo-cutaneous*, *Musculo-spinal*, and *Circumflex Nerves*, the last 2 being derived from the posterior cord.

THE BRANCHES of the brachial plexus are as follows, viz.—

Above the clavicle are given off 4, the—

Communicating, completing the phrenic nerve.

Muscular, to the longus colli, scaleni, rhomboidei, and subclavius muscles.

Posterior, or Long Thoracic, external respiratory nerve of Bell, to the serratus magnus, arising from the 5th and 6th cervical.

Suprascapular, from the 1st trunk of the plexus, to the scapular muscles.

Below the clavicle are 12, the,—

2 Anterior Thoracic, from outer and inner cords to the pectoral muscles.

3 Subscapular, from the posterior cord, to the subscapularis, teres major, and latissimus dorsi muscles.

Circumflex, from the posterior cord, to the muscles and integument of the shoulder, and the shoulder-joint.

Musculo-cutaneous, from the outer cord, to the forearm externally, piercing the coraco-brachialis muscle.

Internal Cutaneous, from the inner cord, to the arm and forearm.

Lesser Internal Cutaneous (nerve of Wrisberg), from the inner cord to the inner side of the arm. Is sometimes wanting, sometimes connected with the intercosto-humeral.

Median, from outer and inner cords, passes between the two heads of the pronator radii teres, supplying the pronators, flexors, first 2 lumbricales, and the integument of the thumb, 2½ fingers, and the radial side of the palm. Its branches are all in the palm, the—

Muscular. Anterior Interosseus. Palmar Cutaneous.

Ulnar, from the inner cord, passes between the two heads of the flexor carpi ulnaris at the inner condyle of the humerus, supplying the elbow- and wrist-joints, several muscles, and the palmar and dorsal integument of the little finger and half of the ring finger. Branches are the—

2 Articular. Cutaneous. Superficial Palmar.
Muscular. Dorsal. Deep Palmar.

Musculo-spiral, from the posterior cord, accompanies the superior profunda artery and vein in the spiral groove of the humerus, and at the external condyle it divides into the radial and posterior interosseus nerves. Its branches are—

Muscular. Cutaneous. Radial. Posterior Interosseous.

The Radial supplies the outer side and ball of the thumb, and the dorsal integument of 2½ fingers.

The Posterior Interosseus supplies all the muscles on the back of the forearm except 3, and also sends a filament to the wrist-joint.

What is the Intercosto-humeral Nerve? It is the lateral cutaneous branch of the 2d intercostal (anterior branch of the 2d dorsal); it pierces the external intercostal muscle and crosses the axilla, joining with a filament from the lesser internal cutaneous (nerve of Wrisberg), and supplying the skin of the upper half of the inside of the arm.

Describe the Lumbar Plexus. It is formed by communicating loops from the anterior branches of the first 4 lumbar nerves, in the following manner.

From the FIRST lumbar nerve are given off the—

Ilio-hypogastric, to the abdominal and gluteal regions.

Ilio-inguinal, to the inguinal region and the scrotum.

Communicating Loop, to the second lumbar nerve.

From the SECOND lumbar nerve are given off the—

External Cutaneous, to the integument of the outside of the thigh.

Genito-crural, to the spermatic cord and front of the thigh.

Communicating Branch, to the third lumbar nerve.

From the THIRD and FOURTH lumbar nerves are given off the following by a branch of origin from each, viz.—

Obturator, through the obturator foramen to the external obturator and adductor muscles and the hip- and knee-joints.

Accessory Obturator (often absent), to the pectineus and hip-joint.

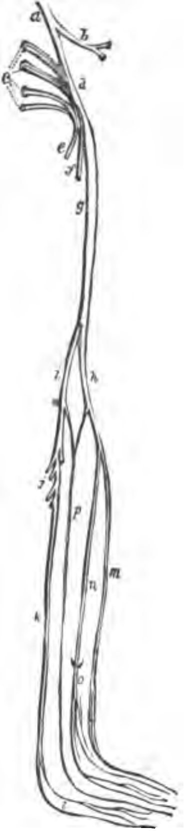
Communicating, from the 3d lumbar to the 4th.

Communicating, from the 4th lumbar to the 5th.

Anterior Crural, which descends through the psoas muscle, and beneath Poupart's ligament to the thigh, where it divides into an anterior and posterior division. Its branches are,—

To the Iliacus muscle.
To the Femoral artery.
Middle and Internal Cutaneous.
Long Saphenous.
Muscular.
Articular.

FIG. 63.



Describe the Sacral Plexus.[d] It is formed by the union of the upper 4 sacral nerves[c] with the 5th lumbar and a loop from the 4th, the two latter forming the *Lumbo-sacral Cord.*[a] It lies upon the pyriformis muscle and gives off the following 5 branches, viz.—

Superior Gluteal,[b] from the lumbo-sacral cord, supplies the glutei and tensor vaginæ femoris.

Muscular Branches, to the pyriformis, obturator internus, gemelli, and quadratus femoris muscles.

Pudic,[e] escapes by the great sacro-sciatic foramen, crosses the ischiatic spine, and re-enters the pelvis by the lesser sacro-sciatic foramen, supplying the perineum, anus, and genitalia.

Small Sciatic,[f] to the gluteus maximus, and integument of the perineum, scrotum, and back of the thigh and leg.

Great Sciatic,[g] the largest nerve of the body, and the direct continuation of the sacral plexus, escapes by the great sacro-sciatic foramen, sends an *Articular Branch* to the hip-joint, *Muscular* branches to the adductor magnus, semimembranosus, semitendinosus, and biceps muscles, and terminates in the *External*[h] and *Internal*[i] *Popliteal* nerves, generally about the lower one-third of the thigh.

Describe the External Popliteal Nerve. It passes from the bifurcation of the great sciatic along the outer side of the popliteal space, gives off *Articular* and *Cutaneous* branches, and about an inch below the head of the fibula it divides into the—

Anterior Tibial,[m] supplying the extensors, and the integument of the adjacent sides of the great and 2d toes.

Musculo-cutaneous,[n] by 2 branches (internal and external) to the peroneal muscles, the integument of the ankles, and the dorsal integument and sides of all the toes, except the outer side of the little toe and the adjoining sides of the great and 2d toes.

Describe the Internal Popliteal Nerve. It is the largest of the two, and descends along the middle of the back of the leg, becoming the *Posterior Tibial*[k] at the lower border of the popliteus muscle, and dividing into the *External* and *Internal Plantar*[l] below the inner malleolus. Its branches are as follows:—

Articular, 3 in number, to the knee-joint.

Muscular, to the gastrocnemius, soleus, plantaris, and popliteus.

External or Short Saphenous,[p] formed by a filament from both popliteal nerves, supplies the integument of the little toe and outer side of the foot.

Muscular, to the tibialis posticus, flexor longus pollicis, and flexor longus digitorum.

Plantar Cutaneous, to the skin of the heel and inner sole of the foot.

Internal Plantar, to the inner plantar muscles, sole of the foot, and the plantar integument of the inner 3½ toes.

External Plantar, to the external plantar muscles, and the plantar integument of the outer 1½ toes.

THE SYMPATHETIC NERVE.

What is the Sympathetic Nerve? It consists of a series of ganglia situated on each side of the vertebral column, connected together and to the cerebro-spinal system by intervening cords, beginning in the *ganglion of Ribes* on the anterior communicating artery, and ending in the *ganglion impar*, in front of the coccyx.

Name the Ganglia of the Sympathetic in the Cranium and its vicinity. They are 9 in number, as follows:—

Ganglion of Ribes, on the anterior communicating artery.
Ganglion of Laumonier, on the internal carotid artery.
Ciliary, or Ophthalmic Ganglion, in the orbital cavity.
Spheno-palatine (Meckel's) Ganglion, in the spheno-maxillary fossa.
Otic (Arnold's) Ganglion, under the foramen ovale.
Submaxillary Ganglion, above the submaxillary gland.
Ganglion of Cloquet, in the incisive fossa, on the naso-palatine nerve.
Ganglion of Bidder, below the foramen spinosum, on the middle meningeal artery.
Ganglion of Bochdalek, on a branch between the spheno-palatine ganglion and the anterior dental nerve at their junction.

Describe the Ganglia connected with the 5th Cranial Nerve. There are 4 such, each having a motor, a sensory, and a sympathetic root, viz.—

Ciliary, or Ophthalmic Ganglion, is situated in the orbit, between the optic nerve and the external rectus muscle. Its sensory root is derived from the nasal branch of the ophthalmic, its motor root from the 3d nerve, its sympathetic root from the cavernous plexus. Its branches are the short ciliary nerves, and are distributed to the ciliary muscle and the iris.

Spheno-palatine, or Meckel's Ganglion, is a large ganglion situated in the spheno-maxillary fossa. Its sensory root is derived from the superior maxillary, its motor root from the facial by the Vidian and large petrosal, its sympathetic root from the carotid plexus, by the carotid branch of the Vidian. Its branches are the—

Ascending.
Anterior Palatine.
Posterior Palatine.
Middle Palatine.
Superior Nasal.
Naso-palatine.
Pharyngeal, or Pterygo-palatine.

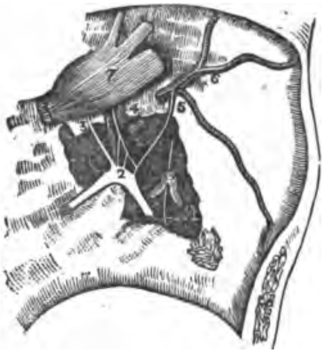
Otic Ganglion (Arnold's), is situated on the inferior maxillary nerve, immediately below the foramen ovale. Its sensory root is derived from the auriculo-temporal branch of the inferior maxillary; its motor root from the internal pterygoid branch of the same, also from the facial and glosso-pharyngeal by the small petrosal; its sympathetic root from the middle meningeal plexus. Its branches are distributed to the tensor palati and tensor tympani muscles.

Submaxillary Ganglion, is situated above the submaxillary gland. Its sensory root is derived from the gustatory branch of the inferior maxillary, its motor root from the facial by the chorda tympani, its sympathetic root from the facial plexus. Its branches are distributed to the submaxillary gland, its duct, and the mucous membrane of the mouth.

What Nerves appear on removing the Gasserian Ganglion? The three Petrosal branches of the 7th nerve (see page 131), lying on the petrous portion of the temporal bone, and communicating with the sympathetic system as follows, viz., the—

Large Superficial Petrosal,[3] (Great Petrosal),—a branch of the 7th nerve, from its geniculate ganglion,[2] (intumentescia gangliformis), which passes through the hiatus Fallopii, and thence through the foramen lacerum medium to the Vidian canal, where it joins the large deep petrosal from the carotid plexus, to form the Vidian nerve, as which it goes to Meckel's ganglion (page 137), forming its motor root.

FIG. 64.



Small Superficial Petrosal,[4] (Small Petrosal), immediately external to the preceding, going from the geniculate ganglion of the 7th to the otic ganglion, and lying directly over the tensor tympani muscle.

External Superficial Petrosal,[5] (External Petrosal),—going from the 7th to the sympathetic plexus on the middle meningeal artery.[6]

Describe the Cervical Ganglia. They are 3 in number on each side, of which the superior is the largest, communicate with each other, and are as follows, viz.—

Superior Cervical Ganglion, lies behind the carotid sheath opposite the 2d and 3d cervical vertebræ. Its branches are distributed to the carotid, cavernous, and pharyngeal plexuses, and one of its internal branches is the superior cardiac nerve going to the cardiac plexus.

Middle Cervical Ganglion, on the superior thyroid artery, opposite the 5th cervical vertebra, and gives off the middle cardiac nerve to the cardiac plexus, also communicating branches.

Inferior Cervical Ganglion, on the superior intercostal artery, between the neck of the 1st rib and the transverse process of the 7th cervical vertebra. It gives off several communicating branches and the inferior cardiac nerve to the cardiac plexus.

What are the other Ganglia of the Sympathetic? There are on each side of the vertebral column 11 or 12 dorsal ganglia, 4 or 5 lumbar, 5 sacral, besides the single coccygeal *Ganglion Impar* in which terminates the double chain. Connected with the viscera are many ganglia, from which branches ramify around the arteries in plexuses named from their locations.

Describe the Splanchnic Nerves. They are 3 in number on each side, and are derived from branches of the 6 lower thoracic ganglia, as follows, viz.—

Great Splanchnic, from branches of the 6th to the 10th, connecting with the upper six, passes through the posterior mediastinum, perforates the crus of the diaphragm, to the semilunar ganglion.

Lesser Splanchnic, from the 10th and 11th, passes through the diaphragm with the great splanchnic, to the cœliac plexus.

Smaller or Renal Splanchnic, from the last thoracic ganglion, also perforates the diaphragm, and ends in the renal and cœliac plexuses.

Describe the Solar Plexus. This plexus, called also the "abdominal brain," is a network of nerves and ganglia, chiefly formed by the splanchnic nerves and the right pneumogastric. It lies behind the stomach, and in front of the aorta and the crura of the diaphragm, surrounding the cœliac axis and the root of the superior mesenteric artery. Its two largest ganglia are the *Semilunar Ganglia* situated in front of the crura of the diaphragm. From it are derived branches which form *Plexuses* over most of the abdominal arteries, as follows:—

Phrenic.	*Gastric.*	*Splenic.*	*Renal.*	*Superior Mesenteric.*
Cœliac.	*Hepatic.*	*Suprarenal.*	*Spermatic.*	*Inferior Mesenteric.*

Describe the Carotid and Cavernous Plexuses. They are two plexuses of the sympathetic, situated on the internal carotid artery, the Carotid lying on the outer side of the artery, as it lies by the side of the body of the sphenoid bone; and the Cavernous being on the inner side of the artery, below its last bend, in the upper portion of the cavernous sinus. The—

Carotid Plexus,—is connected by numerous filaments with the 6th nerve and the Gasserian ganglion, and furnishes the *Large Deep Petrosal* to unite with the large superficial petrosal of the facial, to form the Vidian nerve; also the *Small Deep Petrosal*, to join the tympanic plexus probably.

Cavernous Plexus,—communicates with the 3d and 4th nerves and the ophthalmic division of the 5th, and gives a branch to the Ciliary ganglion in the orbit.

Mention some other Plexuses of the Sympathetic system. They are very numerous; besides those already mentioned, the most important are the following:—

Tympanic Plexus,—described under Nerves of the Tympanum.

Meningeal Plexus, on the middle meningeal artery.

Facial Plexus, surrounding the facial artery.

Cardiac Plexuses, the deep in front of the bifurcation of the trachea, the superficial in front of the right pulmonary artery; the first named lies behind the arch of the aorta, the latter beneath it.

Coronary Plexuses, anterior and posterior, accompanying respectively the left and right coronary arteries.

Aortic Plexus, on the sides and front of the aorta between the superior and inferior mesenteric arteries.

Hypogastric Plexus, on and between the common iliac arteries; supplying the viscera of the pelvic cavity.

Inferior Hypogastric or Pelvic Plexuses, two in number, one on each side of the rectum and bladder. Their branches are the—

Inferior Hemorrhoidal Plexus.	Small Cavernous Nerve.
Vesical and Prostatic Plexuses.	Large Cavernous Nerve.
Vaginal Plexus.	Uterine Nerve.

What is the Vidian Nerve? It has generally been described as a branch of the spheno-palatine (Meckel's) ganglion (see p. 137), running backwards through the Vidian canal, and dividing into a *Petrosal Branch* to the Facial nerve, and a *Carotid Branch* to the carotid plexus of the Sympathetic. It is now, however, more correctly described as a short nerve of communication between the Facial and the Sympathetic on the one hand, and the Spheno-palatine Ganglion on the other, supplying that ganglion with its motor and vaso-motor roots. It is formed by the junction of the—

Large Superficial Petrosal, Br. of the Facial (p. 138), with the—

Large Deep Petrosal, Br. of the Carotid Plexus (p. 140), which occurs in the cartilage filling in the foramen lacerum medium (p. 35). It then enters the Vidian Canal (p. 20), in the pterygoid process of the sphenoid bone, passing through which to finally join the posterior part of the spheno-palatine ganglion (p. 137). Some filaments, the—

Upper Posterior Nasal Branches,—are apparently given off from the Vidian in the canal, to the septum and roof of the nose; but they are really branches from the ganglion, bound up in the same sheath with the Vidian nerve.

VISCERAL ANATOMY.

What is a Viscus? Viscus, *gen.* visceris, *pl.* viscera, is a term which is applied to any internal organ of the body. *The Viscera* are the organs contained in the three great cavities—cranium, thorax and abdomen—with their appendages. Of these the Heart and Brain have been described, with the circulatory and nervous systems respectively. [*See* pp. 99, 120; also the COMPEND OF PHYSIOLOGY in this series.]

THE DIGESTIVE ORGANS.

What is the Alimentary Canal? A musculo-membranous tube, from 25 to 30 feet in length, extending from the mouth to the anus, lined throughout with mucous membrane, furnished with several accessory organs, and performing the functions of ingestion, digestion, and egestion.

Name its Subdivisions. They are the Mouth, Pharynx, Œsophagus, Stomach, Small Intestine (duodenum, jejunum and ileum) and Large Intestine (cæcum, colon and rectum). The first three lie above the diaphragm, the rest below it.

Name the Accessory Organs of Digestion. They are—the Teeth, Salivary glands (parotid, sub-maxillary, sub-lingual), Liver, Pancreas and Spleen.

THE TEETH.

What are the Teeth? They are 32 organs of digestion (20 being temporary, or milk-teeth), situated one-half in each jaw, imbedded in the alveolar processes, and partly surrounded by the *Gums*, which are composed of fibrous tissue and covered with mucous membrane. In each half of each jaw there are—

Temporary Teeth (5)—2 Incisors, 1 Canine, 2 Milk-molars.
Permanent Teeth (8)—2 Incisors, 1 Canine, 2 Bicuspids, 3 Molars.

What are their General Characteristics? Each tooth presents a—

Crown, or Body,—the part seen projecting above the gum.
Neck,—the constricted portion between the crown and the fang.
Fang, or Root,—imbedded in the alveolus; and surrounded by the periodental membrane or periosteum lining the alveolus.

Pulp-cavity,—in the interior, opening at the apex of the fang for the entrance of vessels and nerves.

State the Characteristics of each class of Teeth.

Incisors, or Cutters.—Crown chisel-shaped, beveled posteriorly. Fang single, long, thickest antero-posteriorly.

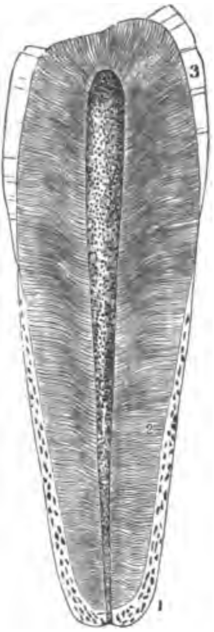
Canines, or Tearers,—Crown thick and conical. Fang longest and thickest of all the teeth, forming a projection on the alveolar arch. The 2 upper canines are the "eye-teeth."

Bicuspids,—Crown has 2 cusps. Fang single but grooved deeply, showing a marked tendency to bifurcate.

Molars, or Grinders,—Crown large, low and cuboid in shape, has 4 cusps on upper molars, 5 on the lower ones. Fangs multiple, usually 3 on the first two upper molars, 2 on the first two lower ones; the third molar of either jaw, having but one fang, is called the "wisdom tooth," and is the smallest of the three.

The 2d or 3d Temporary Molar is larger than the first.

FIG. 65.



Describe the Structure of a Tooth. Each consists of—

Dentine or Ivory,[2]—composed of tubules surrounded by the inter-tubular tissue or Matrix and opening into the pulp cavity. It resembles compact bone in appearance and in composition, consisting of 28 parts Animal matter and 72 Earthy matter. The *Tubules* are delicate wavy canals, diameter about $\frac{1}{4500}$ of an inch, which branch outwardly and anastomose with each other, forming concentric shadings or *Schreyer's Lines*.

Enamel,[3]—covers the crown; consists of very dense tissue, which contains but 3½ per cent. of animal matter. It is covered by a very delicate epithelial cuticle, *Nasmyth's Membrane*, which when intact withstands the action of acids.

Crusta Petrosa or Cement,[1]—the enamel of the fang; is a layer of true bony tissue, containing lacunæ, canaliculi, and Haversian canals.

Pulp,—fills the pulp-cavity and is prolonged into the dental tubules; is soft vascular, and sensitive; and consists of connective and fibrous tissue nucleated cells, blood-vessels and nerves. The cells are caudate and anastomose with each other, those situated superficially being termed *Odontoblasts.*

What Arteries and Nerves supply the Teeth? *The Arteries* are derived from the inferior dental, and from the alveolar and infraorbital branches of the internal maxillary. *The Nerves* are derived from the inferior dental branch of the inferior maxillary division of the 5th, and also from the anterior and posterior dental branches of the superior maxillary division of the same nerve.

When do the Temporary Teeth appear? Their eruption begins about the 7th month after birth, with the central incisors, and ends with the appearance of the second molars, about the age of two years. The lower teeth slightly antedate the upper. Their formula is as follows:—

	Mo.	Mo.	Ca.	In.	In.	In.	In.	Ca.	Mo.	Mo.		
Upper...	1	1	1	1	1	1	1	1	1	1	= 10	=20
Lower...	1	1	1	1	1	1	1	1	1	1	= 10	
	24	12	18	9	7	7	9	18	12	24 months.		

When do the Permanent Teeth appear? The first molars appear about the end of the 6th year, followed by the incisors about the 7th or 8th year, the bicuspids from the 9th to the 10th year, the canines about the 11th or 12th year, the second molars from the 12th to the 13th year, and the third molars from the 17th to the 25th year. Those of the lower jaw are slightly in advance of the corresponding upper ones. Their formula is as follows:—

	Wis.	Mo.	Mo.	Bi.	Bi.	Ca.	In.	In.	In.	In.	Ca.	Bi.	Bi.	Mo.	Mo.	Wis.		
Upper.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	= 16	32.
Lower.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	= 16	
	18	12	6	10	9	11	8	7	7	8	11	9	10	6	12	18 years.		

What is the greatest Number of Teeth at one time in the jaws, and when? Forty-eight, namely, all the temporary and permanent teeth except the third molars,—occurring between the 5th and 7th years of age.

Describe the Development of the Teeth. They arise from the mucous membrane covering the maxillary arches, in which, about the 6th fœtal week, appears a depression, the *Primitive Dental Groove*, from the floor of which arise papillæ of mucous membrane to form the pulp of the milk-teeth.

In the *Follicular Stage*, membranous septa form across the groove, and its margins become thick and prominent.

The Saccular Stage extends from the 13th week to the 16th, and is marked first by the projection of the papillæ from the follicles, next by the growth of the follicular margins, the formation of processes or *Opercula* thereon, which meet and close in the papillæ; and finally by the closing in of the dental groove by the union of its margins. A *Cavity of Reserve* for each tooth is then formed by the closure of the secondary dental groove, from the floor of which another papilla arises to form the germ of the permanent tooth.

The dental pulps now take the forms of teeth, a thin lamina of dentine appears and increases from without inward, the enamel organ and membrane are formed, and when calcification has advanced sufficiently, the pressure of the teeth causes the absorption of the gum above them, the septa ossify and the eruption of the teeth occurs. *The Cement* is formed from the periodental membrane, at a later period of life.

THE MOUTH.

Describe the Mouth. It is an oval cavity formed by the lips, cheeks, jaws, palate and tongue, forming the superior portion of the alimentary canal and opening posteriorly into the pharynx by the fauces. It presents the teeth (already described), the tongue (to be described), and also the—

Hard Palate, formed by the palate processes of the superior maxillary and palate bones, and covered with mucous membrane; forms the roof of the mouth.

Soft Palate, formed by 5 muscles on each side, viz., the levator palati, tensor palati, palato-glossus, palato-pharyngeus, and the azygos uvulæ;—the latter forming with its fellow the *Uvula*, a descending muscular projection.

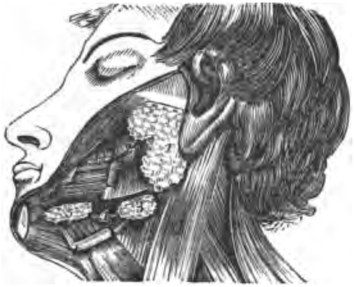
Anterior Pillars of the Fauces,—arch downwards and forwards to the base of the tongue, and contain the palato-glossi muscles.

Posterior Pillars of the Fauces,—arch downwards and backwards to the sides of the pharynx, and contain the palato-pharyngei muscles.

Isthmus Faucium,—the space bounded by the pillars, the free border of the palate, and the base of the tongue.

Tonsils,—are small, elongated, glandular bodies, situate done on each side of the fauces, between the anterior and posterior pillars. Each has 12 or 1 openings on its surface leading to follicular depressions within the gland, and lies close to the internal carotid artery.

FIG. 66.



Openings of Steno's Ducts,—from the parotid glands, are situated internally one on each cheek, opposite the 2d upper molar tooth.

Openings of Wharton's Ducts,—from the sub-maxillary glands, one at each side of the frenum of the tongue.

penings of the Ducts of Rivinus,—8 to 18 on each side from the sublingual glands, near the frenum of the tongue. The longest is the *Duct of Bartholine*, which opens into the duct of Wharton.

Where are the Salivary Glands? The *Parotid Gland*[1] lies below and front of the external ear,—the *Sub-maxillary*[3] and *Sub-lingual*[5] *Glands* in the corresponding fossæ on the inner surface of the inferior maxillary one. [See Fig. 66.]

Describe the Tongue. The tongue consists of extrinsic and intrinsic uscles, a hyo-glossal membrane and a mucous membrane, a median fibrous eptum, vessels and nerves. Its *Base* is attached to the hyoid bone, the epilottis, the soft palate and the pharynx. Its *Under Surface* is attached to the yoid bone and the inferior maxillary. Its mucous membrane is reflected ver the floor of the mouth to the inner surface of the gums, forming in front fold, the *Frenum Linguæ*.

The Tongue presents—

Filiform Papillæ, along its sides, closely packed in rows.

Fungiform Papillæ,[2] scattered over the anterior two-thirds of its dorsum.

Circumvallate Papillæ,[1] 7 to 12 in number, in two rows, forming a V at the base of the tongue, meeting at the *Foramen Cæcum*, which contains the central papilla.

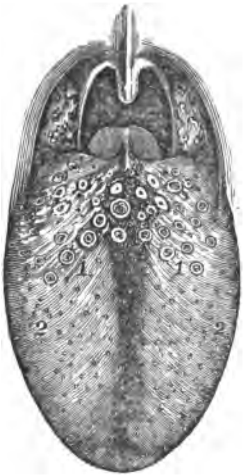
Follicular Glands, posteriorly to the circumvallate papillæ.

Racemose Glands, over the dorsum, sides, and under surface. Beneath the tip they form two small oblong masses.

Extrinsic Muscles, are the stylo-, hyo-, genio-hyo-, and palato-glossus muscles. [See pp. 73, 74.]

Intrinsic Muscles, are the several fibres of the lingualis muscle,—superior, inferior, transverse and perpendicular.

FIG. 67.



Name the Arteries of the Tongue. They are the—

ingual, branch of the external carotid,—with its branches, the—

Dorsalis linguæ. Sub-lingual. Ranine.

ub-mental, branch of the facial,—anastomoses with the sub-lingual.

scending Pharyngeal, branch of the external carotid,—sends some small branches to the pharynx and tongue.

What Nerves are distributed to the Tongue? The—

Gustatory Branch of the 5th,—to the mucous membrane of the sides and anterior two-thirds of the tongue, endowing it with general sensibility.

Chorda Tympani Branch of the 7th,—joins the gustatory, and is distributed to the same region, being the nerve of taste for the anterior two-thirds of the tongue.

Lingual Branches of the 9th or Glosso-pharyngeal,—to the mucous membrane of the base and sides of the tongue, being the nerve of taste for its posterior third.

Hypoglossal, or 12th,—to the intrinsic and extrinsic muscles of the tongue, being its nerve of motion.

Superior Laryngeal Branch of the 10th or Pneumogastric,—sends a few fibres to the base of the tongue from its internal branch.

What special Anatomical Features are presented by the Mouth? They are as follows, viz.—the—

Hamular Process of the Sphenoid Bone,—may be felt behind the last upper molar tooth; also the *Internal Pterygoid Plate*, and part of the *Pterygoid Fossa*.

Coronoid Process,—of the lower jaw, its anterior border.

Posterior Palatine Artery,—at inner side of the last upper molar tooth, and in front of the hamular process.

Gustatory Nerve,—very near the last lower molar tooth.

Pterygo-maxillary Ligament,—felt as a fold posteriorly to the last lower molar tooth.

THE PHARYNX.

Describe the Pharynx. It is a conical, musculo-membranous bag, about 4½ inches long, hung base up from the basilar process of the occipital bone, and extending to the lower border of the cricoid cartilage posteriorly, or the 5th cervical vertebra, where it becomes continuous with the œsophagus.[5] It forms the part of the alimentary canal which lies behind the mouth, being incomplete in front.

What are its Relations? It is connected with—

Posteriorly,—the longus colli and recti capitis antici muscles, and by loose areolar tissue to the first 5 cervical vertebræ.

Laterally,—the styloid processes and their muscles, the pterygoid muscles, the internal carotid arteries, the internal jugular vein, the 8th, 9th, and the sympathetic nerves.

Near its Apex,—the lobes of the thyroid gland, the common carotid and lingual arteries, the sterno-hyoid muscle, and the lingual nerves.

What are its Anterior Attachments? The internal pterygoid plate, pterygo-maxillary ligament, lower jaw, base of the tongue, cornua of the hyoid bone, stylo-hyoid ligament, thyroid and cricoid cartilages of the larynx.

Name the Openings into the Pharynx. They are 7, viz.—

2 Posterior Nares,	Mouth.	Larynx.
2 Eustachian Tubes.		Œsophagus.

Describe its Structure. The pharynx is composed of 3 coats,—a mucous, a muscular and a fibrous, the latter lying between the other two, and sometimes called the *Pharyngeal Aponeurosis.* The mucous coat is covered with ciliated columnar epithelium above the level of the floor of the nares—below that level by squamous epithelium; and contains simple follicular glands, also compound follicular and racemose glands, the latter being most numerous in the upper part, between the two Eustachian tubes.

Name its Muscles, Arteries and Nerves. Its—

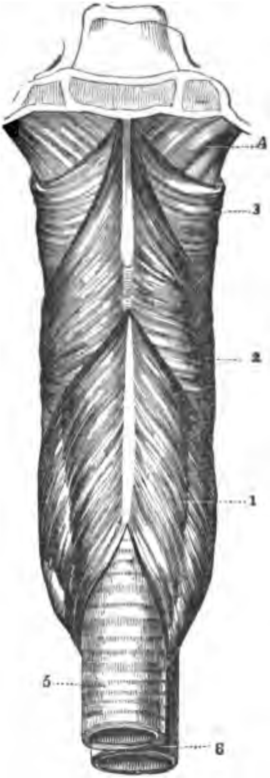
Muscles, 5,—are the Superior, Middle and Inferior Constrictors, Stylo-pharyngeus, and Palato-Pharyngeus. [See pages 73, 74.]

Arteries number 4, as follows,—

Superior Thyroid Branches. Ascending Pharyngeal.	Branches of Ext. Carotid.
Pterygo-palatine. Descending Palatine.	Branches of the Internal Maxillary.

Nerves,—Branches of the Pharyngeal Plexus, which is formed by the pharyngeal branches of the pneumogastric, glosso-pharyngeal, superior laryngeal, and superior cervical ganglion of the sympathetic.

FIG. 68.



THE ŒSOPHAGUS.

Describe the Œsophagus. It is a musculo-membranous tube, about 9 inches long, extending from the 5th cervical vertebra and the lower border of the cricoid cartilage of the larynx, through the œsophageal opening in the diaphragm to the cardiac orifice of the stomach, opposite the 9th dorsal vertebra, where it terminates. It lies in the neck, between the trachea and the vertebral column, resting in part on the longus colli muscle; then inclining to the left side it reaches the posterior mediastinum behind the left bronchus.

Describe its Structure. The Œsophagus has three coats, a—

Mucous,—in thick longitudinal folds, containing compound racemose glands, and covered with a thick layer of squamous epithelium.

Cellular,—forms a loose connection between the other two coats, and contains the œsophageal vessels.

Muscular,—having longitudinal fibres externally, circular fibres internally, which are continuous with the fibres of the stomach below, and with those of the inferior constrictor muscle above.

Name its Vessels and Nerves. The Œsophageal—

Arteries, are chiefly branches from the thoracic aorta.

Veins, empty into the vena azygos minor.

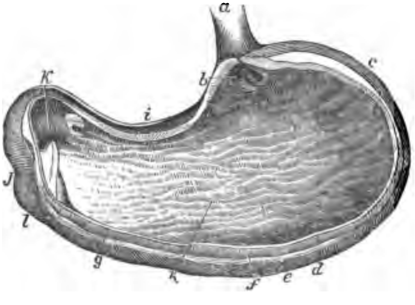
Nerves, are branches of the pneumogastric and the cervical sympathetic, forming the Œsophageal Plexus.

THE STOMACH.

Describe the Stomach. It is the principal organ of digestion, pyriform in shape, of musculo-membranous structure, about 12 inches long by 4 inches in average diameter, held in position by the lesser omentum, and situated diagonally across the upper abdomen, in the epigastric and right and left hypochondriac regions, above the transverse colon, below the liver and diaphragm. It presents for examination a—

Fundus or Splenic End, *c*—connected to the spleen by the gastro-splenic omentum. (See under PERITONEUM.)

FIG. 69.



Pylorus or Lesser End,—lies in contact with the anterior wall of the abdomen, the under surface of the liver, and the neck of the gall-bladder, its position being near the end of the cartilage of the 8th rib.

Greater Curvature, *d* —is convex, and is connected to the colon by the gastro-colic omentum. (See under PERITONEUM.)

Lesser Curvature, i—is concave, and connected to the liver by the gastro-hepatic omentum, and to the diaphragm by the gastro-phrenic ligament.

Œsophageal Orifice, b—is situated between the fundus and the lesser curvature. It is funnel-shaped, and the highest part of the organ.

Pyloric Orifice, k—opens into the duodenum, *l* and is guarded by the circular muscular fibres of the pylorus, which are aggregated into a circular ring, projecting into the cavity, and with its covering fold of mucous membrane, forming the Pyloric Valve.

Describe its Structure. The Stomach has 3 coats, a—

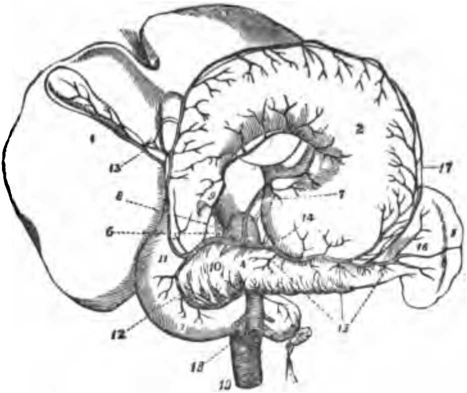
Mucous Coat, g—lined with columnar non-ciliated epithelium, covered with polygonal *Alveoli*, $\frac{1}{150}$ of an inch in diameter, containing the orifices of the *Gastric Follicles.* When the stomach is contracted the mucous membrane lies in longitudinal folds or *Rugæ, h* one of which aids in forming the valve at the pyloric orifice.

Cellular or Sub-mucous Coat,—contains the gastric vessels.

Muscular coat, f—consists of longitudinal, circular, and oblique fibres. *The Longitudinal* are continuous with those of the œsophagus and small intestine, and are the most superficial. *The Circular* lie deeper, and over the whole organ; they form a sphincter valve around the pyloric orifice. (See above.) *The Oblique Fibres* lie deepest, forming two sets around the œsophageal opening, in continuation of the circular fibres of the œsophagus.

THE SEROUS INVESTMENT of the stomach is derived from the peritoneum, and covers the whole external surface, excepting the points where the gastro-splenic, greater and lesser omenta are attached. It is usually, but incorrectly, described as a fourth coat of the stomach.

FIG. 70.



Describe the Gastric Glands. They are of 3 kinds, the—

Peptic Follicles,—situated all over the stomach, but most numerous towards the splenic end,—are tubules lined with columnar epithelium in their upper one-fourth, and filled with nucleated cells in their deepest parts.

Mucous Glands,—are most numerous at the pyloric end; are branched or sacculated, and lined throughout with columnar epithelium.

Simple Solitary Glands are found scattered along the lesser curvature, and near the pyloric end.

Name the Vessels and Nerves of the Stomach. Its—

Arteries are the—

Gastric,[7] Pyloric.[9] Right Gastro-epiploic.[11]	Branches of the Hepatic Artery.[8]
Left Gastro-epiploic.[17] Vasa Brevia.[16]	Branches of the Splenic Artery.[14]

Veins, terminate in the splenic and portal veins.

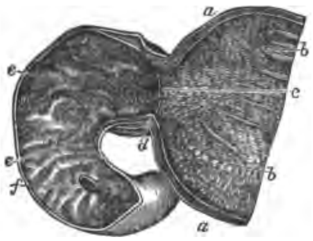
Nerves, are terminal branches of the right and left pneumogastrics, and branches of the semilunar ganglia of the sympathetic, forming the *Gastric Plexus*.

THE SMALL INTESTINE.

Describe the Small Intestine. It is a convoluted, tubular, digestive organ, about 20 feet in length, held to the spinal column by the mesenteric portion of the peritoneum, and divided into 3 parts, the—

Duodenum,—about 12 fingers (10 inches) long, *ascends* for 2½ inches to the under surface of the liver and the neck of the gall-bladder,—*descends* for 3½ inches in front of the right kidney,—and passes transversely for 4 inches to the left, across the spinal column, to the left side of the second lumbar vertebra, where the superior mesenteric artery crosses its junction with the jejunum. The duodenum has no mesentery, is partially covered with peritoneum, and surrounds the head of the pancreas. Into its descending portion open the ductus communis cholédochus *f* and the pancreatic duct.

FIG. 71.



Jejunum,—about two-fifths of the rest of the small intestine, its coils lying around the umbilical region. It is named from the fact that it is usually found empty (*jejunus*) after death.

Ileum,—comprises the remainder of the small intestine; is named from its twisted course, lying below the umbilicus, and terminating in the right iliac fossa, at the ileo-cæcal valve, or valve of Bauhin.

What Coats has the Small Intestine? Three, a mucous, a sub-mucous or cellular, and a muscular coat. Its peritoneal investment is sometimes described as a fourth coat, but incorrectly. The—

Mucous Membrane,—is covered with columnar non-ciliated epithelium, and thrown into crescentic transverse folds, the *Valvulæ Conniventes*, or valves of Kirkring. It also presents numerous vascular projections or *Villi*, each formed of basement membrane, epithelium, a lacteal vessel, a capillary plexus, granular corpuscles, and longitudinal muscular fibres, and numbering about four millions in the whole length of the intestine.

Cellular Coat,—contains the vessels of the intestine, and connects the other two coats together.

Muscular Coat,—consists of external longitudinal and internal circular fibres, the former being thinly distributed along the bowel, the latter forming a thick layer, but not making complete rings.

Describe the Glands of the Small Intestine. The mucous membrane of the small intestine contains—

Crypts of Lieberkühn, or Simple Follicles,—are minute tubular depressions, found all over the intestine and also in the stomach.

Brunner's Glands,—are small conglomerate glands, found only in the duodenum and the first part of the jejunum, being most numerous near the pylorus. In structure they resemble the pancreas.

Solitary Glands,—are lymphoid organs, situated throughout the intestine, though most numerous at the lower portion of the ileum. They are agminated into some 20 or 30 oval patches, named—

Peyer's Patches,—on the surface opposite to the mesenteric attachments, some of which are as much as 4 inches in length. They are most numerous and largest in the ileum, and are most developed during digestion.

THE LARGE INTESTINE.

Describe the Large Intestine. It is about five feet long, of large calibre, sacculated, consists of the same coats as the small intestine, the mucous being smooth, and without villi, the muscular having its longitudinal fibres collected into 3 narrow bands, producing a pouching of the tube. It presents the following PARTS and *points*, viz.—

CÆCUM, *or Caput Cæcum Coli*, [c]—a dilated blind pouch behind the entrance of the small intestine.[a] It is the beginning of the large intestine, lies in the right iliac fossa, and is two-thirds covered by peritoneum.

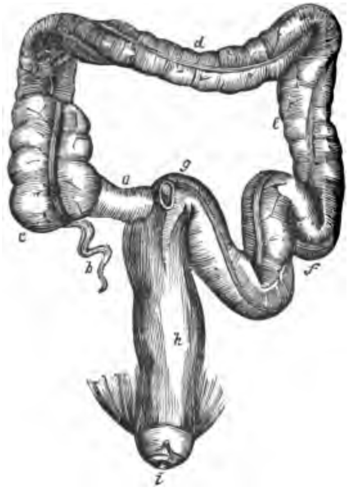
Appendix Vermiformis, [b]—a blind prolongation about 3 to 6 inches long, narrow and worm-like, directed backwards and upwards from the lower part of the cæcum, being retained by a fold of the peritoneum.

Ileo-cæcal Valve, or Valve of Bauhin,—guards the entrance of the small intestine, being formed by two crescentic folds of the mucous and cellular coats and circular muscular fibres, each covered with villi on the side toward the ileum, but smooth on the cæcal side.

Ascending Colon,—extends upwards to the under surface of the liver, where it forms the *Hepatic Flexure of the Colon.*

Transverse Colon, *d*—crosses the abdominal cavity just below the liver, gall-bladder, stomach and spleen, to the left hypochondrium, where it terminates in the *Splenic Flexure of the Colon.*

Fig. 72.



Descending Colon, *e*—passes downwards in front of the left kidney to the left iliac fossa, where it forms the—

Sigmoid Flexure of the Colon, f—curved like an *f*, first upwards, then downwards; extending from the crest of the left ileum to the left sacro-iliac synchondrosis.

Rectum, *h*—from the last-named point to the anus; is 6 to 8 inches long, not sacculated, and, though not straight, is straighter than the rest of the gut. It curves laterally to the middle of the sacrum, and backwards about an inch above its termination at the *Anus*, *i* where it is distended into a pouch. This lower inch has no peritoneal investment.

Appendices Epiploicæ,—are small pouches of peritoneum containing fat, and found along the colon and part of the rectum. They are due to the incompleteness of the investment of the gut by peritoneum.

Sphincters of the Rectum are 3,—the sphincter ani, internal sphincter and sphincter tertius of Hyrtl. (See *ante*, pp. 83, 84.)

Folds of Houston,—three semilunar transverse folds, one in the upper part of the rectum on the right side, another about the middle on the left side, and the third in front, opposite the base of the bladder.

What Glands are found in the Large Intestine? The *Follicles of Lieberkühn* are more numerous here than elsewhere, also a few *Solitary Glands* and *Peyer's Patches* in its upper portion. The glands of Brunner are absent, the villi and valvulæ conniventes are almost wanting.

State the Principal Relations of each of the three parts of the Rectum. They are as follows, viz.—

Upper Part (4 inches),—lies on the left pyriformis muscle and the left sacral plexus; and to its left lie the left ureter and branches of the left internal iliac artery.

Middle Part (3 inches), in the male subject lies just behind the trigonum vesicæ and the vesiculæ seminales, and close below the under surface of the prostate gland. In the female it is adherent to the central portion of the posterior wall of the vagina.

Lower Part (1 inch),—is surrounded by the 3 sphincters and the levator ani muscle, and is separated by the perineum from the membranous portion and bulb of the urethra in the male, from the vagina in the female.

THE LIVER.

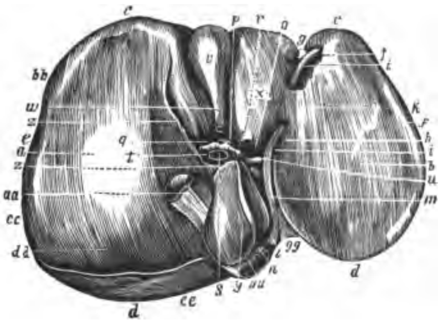
Describe the Liver. It is the largest gland in the body, weighing from 3 to 4 pounds, measuring transversely about 12 inches, antero-posteriorly 6 inches, in greatest thickness 3 inches. It is situated in the right hypochondriac, epigastric and part of the left hypochondriac regions; has 5 fissures, 5 lobes, 5 ligaments, and 5 sets of vessels, and is invested by peritoneum, except for a small space at the attachment of the coronary ligament. It is also surrounded by a fibrous coat which is continuous at the transverse fissure with the capsule of Glisson. Its—

Upper Surface,—is convex, in relation with the under surface of the diaphragm and 6 or 7 lower ribs, and is divided into two lobes by the suspensory or broad ligament.

Under Surface (Fig. 73), is concave, covers the stomach, duodenum, hepatic flexure of colon, right kidney and supra-renal capsule, and is divided into 5 lobes by 5 fissures.

Anterior Border, ᶜ—sharp and notched opposite the fundus of the gall-bladder and the round and falciform ligaments. It corresponds to the lower border of the ribs and costal cartilages, descending a little lower during deep inspiration and in the upright posture.

Fig. 73.



Posterior Border, ᵈ—rounded, and deeply grooved (sometimes channeled) for the inferior vena cava.ᵃᵃ

Describe the 5 Ligaments of the Liver. Four are folds of peritoneum; one, the round ligament, is the obliterated umbilical vein and ductus venosus of the fœtus. The—

Suspensory or Falciform Ligament,j—called also the Broad and the Longitudinal Ligament,—is a sickle-shaped double fold reflected over the round ligament, and is attached to the sheath of the right rectus muscle as low as the umbilicus, and to the diaphragm.

Coronary Ligament,ff—is a double fold, containing firm areolar tissue in its interspace, and extending from the posterior border of the liver to the diaphragm.

Lateral Ligaments, 2,—are the triangular extremities of the coronary ligament.

Round Ligament,i—ascends in the free margin of the suspensory ligament from the umbilicus to the longitudinal fissure, in which it is continued to the vena cava.

Describe the 5 Hepatic Fissures. They are all situated on its under surface, and separate the 5 lobes, one from another. They are the—

Longitudinal Fissure,h—its anterior two-thirds, in front of the transverse fissure, is called the *Umbilical Fissure*, from containing the umbilical vein; its posterior one-third is the *Fissure of the Ductus Venosus*, lodging the slender cord which represents that fœtal vessel.

Transverse Fissure,o—about 2 inches long, running from the longitudinal towards the right; and transmit the portal vein, hepatic artery, bile-duct, lymphatics and nerves, surrounded by the *Capsule of Glisson.*

Fissure of the Gall-bladder,v—on the right of the longitudinal fissure, and nearly parallel with it, extending from the anterior border, backwards to near the right end of the transverse fissure.

Fissure for the Vena Cava,—extends inwards from the posterior border, where it joins the fissure for the ductus venosus; and gives exit to the hepatic veins which here join the vena cava. This fissure is occasionally a complete foramen.

Describe the 5 Hepatic Lobes. Three are mere lobules, formed from the right lobe by the smaller fissures. The—

Right Lobe,a—is much the largest, and presents the three small fissures and two depressions, one anteriorly for the colon, the other posteriorly for the kidney.

Left Lobe,b—is divided from the right by the longitudinal fissure, and rests upon the stomach.

Lobulus Quadratus,x—in front of the transverse fissure, and between the umbilical fissure and that for the gall bladder.

Lobulus Spigelii,y—behind the transverse fissure, and between the fissure for the ductus venosus and that for the vena cava.

Lobulus Caudatus,z—a connecting ridge from the lobulus Spigelii to the right lobe; it separates the transverse fissure from the fissure for the vena cava, and forms the roof of the foramen of Winslow.

Describe the 5 Hepatic Vessels. They are the — portal vein,*s* hepatic rtery,*q* hepatic duct,*p* and lymphatics, situated in the transverse fissure, and rrounded by the capsule of Glisson,—also the hepatic veins in the fissure r the vena cava. The—

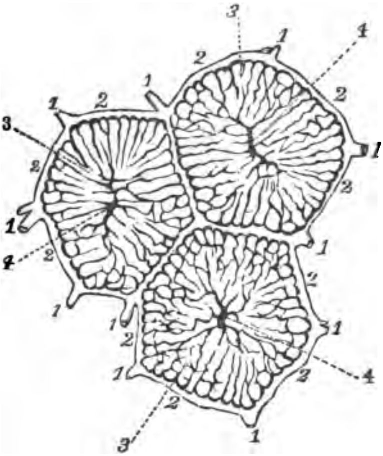
Portal Vein,s—formed by the superior and inferior mesenteric, splenic and gastric veins (all the main veins of the abdomen except the renal), is about 4 inches long. It enters the transverse fissure of the liver, where it divides into two branches, and these again divide and subdivide to ramify throughout the gland. Its branches are the—

Right Portal.	Inter-lobular Veins.[1]	Lobular Plexus. (Fig. 74.)
Left Portal.	Lobular Veins.[3]	
Vaginal Branches.	Intra-lobular Veins.[4]	

Hepatic Veins,—are the continuations of the intra-lobular, beginning as the *Sub-lobular Veins* beneath each lobule, and entering the inferior vena cava in the fissure for that vessel.

Hepatic Artery,q—the nutrient vessel of the liver; arises from the cœliac axis, enters the transverse fissure, and divides into branches which supply the cellular tissue, the walls of the vessels, and the investing membranes of the liver, also forming a plexus in each lobule which anastomoses with the terminal branches of the portal vein.

FIG. 74.



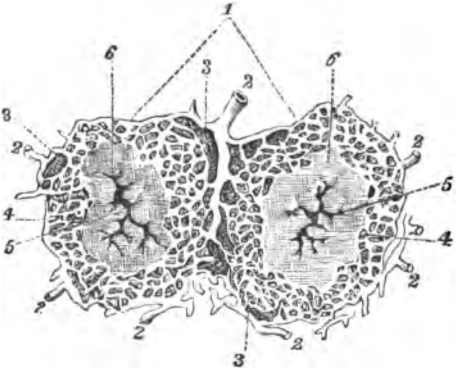
Hepatic Duct,—about 1½ inch long; is formed in the transverse fissure by the union of the two main biliary ducts, from the right and left lobes. It joins the cystic duct from the gall-bladder to form the Ductus Communis Cholédochus. (See next page.)

Lymphatics,—accompany the blood vessels in two sets, a superficial set and a deep one.

What Nerves supply the Liver? Branches of the Hepatic Plexus, which is formed by branches derived from the left pneumogastric, right phrenic and solar plexus.

Describe the Structure of the Liver. The substance of the liver is composed of numerous *Lobules*,[1] of polygonal shape, and about $\frac{1}{20}$ of an inch in diameter, clustered around the sublobular branches of the hepatic veins, and connected together by connective tissue,[3] blood vessels, ducts,[2] and lymphatics. Each lobule consists of—

FIG. 75.



Hepatic Cells,—each about the $\frac{1}{1500}$ of an inch in diameter, having a nucleus and nucleolus, yellow coloring matter, glycogen granules, and oil globules.

Lobular Veins,[3]—forming a plexus in the lobule.
Intra-lobular Vein,[4]—in the centre of each lobule. } (See Figs. 74, 75.)
Plexuses,—of lymphatics, nerves, and bile-ducts.

What is the Capsule of Glisson? The areolar tissue which surrounds the hepatic vessels in the transverse fissure, and accompanies them in their course throughout the substance of the liver. It is continuous with the fibrous covering of the organ.

How may the Portal Veins be distinguished from the Hepatic, on section of the Liver? The portal veins remain closed, being surrounded by the capsule of Glisson. The hepatic veins gape open, being adherent to the liver substance.

Describe the Gall-bladder. It is a pear-shaped bag, 3 to 4 inches long, an inch in greatest diameter, holding from 8 to 12 fluid drachms, invested by peritoneum on its under surface and fundus, formed of a fibro-muscular coat and lined by a mucous one, lying in a fissure on the under surface of the liver, close to its anterior border, and directed obliquely downwards, forwards, and to the right. Its—

Fundus,—touches the abdominal wall immediately below the 9th costal cartilage, and is completely invested by peritoneum.

Neck,—coils twice upon itself, and empties into the *Cystic Duct*, which is about an inch long, and joins with the *Hepatic Duct* to form the Ductus Communis Cholédochus.

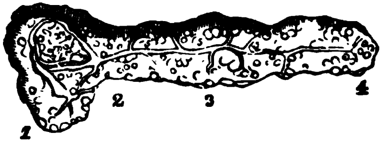
What is the Ductus Communis Cholédochus? A fibro-muscular tube, covered by peritoneum and lined with mucous membrane, about 3 inches in length, formed by the junction of the Cystic and Hepatic ducts, and emptying its contents (bile) into the descending part of the duodenum at a point about 3 inches from the pyloric orifice of the stomach, generally in common with the duct of the pancreas. The three ducts above-named are often called the *Biliary Ducts*.

THE PANCREAS.

Describe the Pancreas. The Pancreas is a racemose gland, about 7 inches long, of a grayish-white color, situated behind the stomach and in front of the first lumbar vertebra. Its structure resembles that of the salivary glands, being composed of reddish-yellow lobules, united by cellular tissue, vessels and ducts, and ending in closed pouches surrounded by a capillary plexus. The—

Pancreatic Duct, or Duct of Wirsung,[5]—extends the whole length of the gland, and opens into the duodenum about 3 inches below the pylorus, by an orifice common to it and the ductus communis cholédochus.

Fig. 76.



Head, or Right Extremity,[1] is surrounded by the curve of the duodenum, the ductus communis cholédochus and the pancreatico-duodenal arteries.

Tail, or Left Extremity,[4]—lies above the left kidney and in contact with the lower end of the spleen.

Body[3]—is in relation *anteriorly* with the ascending layer of the transverse meso-colon, the posterior wall of the stomach and the transverse colon; *posteriorly* with the aorta, portal vein, inferior vena cava, splenic vein, origin of the superior mesenteric artery, crura of the diaphragm, left kidney and supra-renal capsule, and the left quadratus lumborum muscle.

Arteries, are the—

Pancreatica Magna, and Pancreaticæ Parvæ, from the splenic.
Pancreatico-duodenalis,—branch of the hepatic artery.
Inferior Pancreatico-duodenalis,—branch of the sup. mesenteric.

Veins,—open into the splenic and mesenteric veins.

Nerves,—from the solar plexus, forming a Splenic Plexus.

What is the Lesser Pancreas? A lobe of the head of the pancreas; sometimes detached therefrom, in which case it opens by a duct into the duodenum about an inch above the orifice of the pancreatic duct.

THE DUCTLESS GLANDS.

Name the so-called Ductless Glands. They are the Spleen, Supra-renal Capsules, Thyroid and Thymus Glands. The first two are in the abdominal cavity, the thyroid gland is in the front of the trachea, and the thymus gland is in the anterior mediastinum of the thorax. These organs have no excretory ducts, and their functions are unknown.

THE SPLEEN.

Describe the Spleen. The spleen is a soft, spongy and very vascular organ, about 5 by 3 by 2 inches, from 6 to 10 ounces in weight, and situated deeply in the left hypochondrium, embracing the cardiac end of the stomach, to which it is connected by the gastro-splenic omentum. Its—

Outer Surface,—is convex, corresponds to the 9th, 10th and 11th ribs, and is in relation with the inferior surface of the diaphragm.

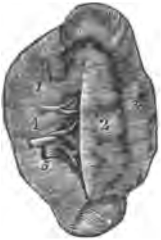
Inner Surface,—is concave, and embraces the cardiac or splenic end of the stomach.

Borders,—the anterior is thin and often notched; the posterior is thick and lies on the left kidney.

Suspensory Ligament,—attaches the upper extremity the diaphragm, and is a fold of peritoneum.

Hilum,—a vertical fissure about the middle of the concave surface. It is pierced by the vessels, lymphatics and nerves.

FIG. 77.



Peritoneal, or Serous Coat,—covers the whole organ, except at the attachments of the suspensory ligaments and the gastro-splenic omentum.

Fibro-elastic Coat, or Tunica Propria,—is reflected at the hilum upon vessels, and gives off numerous bands (*trabeculæ*), which bound lacunar spaces (*areolæ*) of the organ.

Malpighian Corpuscles,—are lymphoid sphenoidal expansions of outer coat of the small arteries, and average in diameter about the of an inch. They are attached to the arterioles of the organ in gro of 6 or 8, and are usually pierced by an artery. Their reticulum is slen and open, densely filled with lymphoid corpuscles, and well suppl with capillaries. They have no capsule.

Splenic Substance or Pulp,—a soft, pulpy, brown-red mass, surrounding the Malpighian corpuscles, and contained in the areolæ. It consists of a delicate net-work of connective-tissue corpuscles, containing pigment-granules (disintegrated blood-corpuscles), granular albuminous matter, nucleated and non-nucleated cells, and free nuclei, also red blood-corpuscles in every stage of metamorphosis. These are denominated the colored and colorless elements.

Splenic Artery,—is large and tortuous, and divides at the hilum into 5 or 6 branches, each supplying a segment of the organ, and terminating either directly in the venous radicles, or in the lacunar spaces.

Splenic Vein,—arises by radiçles partly from the capillaries, partly from the lacunar spaces, and empties into the portal vein.

Nerves,—are derived from the semi-lunar ganglion of the solar plexus and the right pneumogastric, forming the *Splenic Plexus*.

THE THYROID GLAND.

Describe the Thÿroid Gland. It is a bi-lobed organ, about 3 inches in ength, situated on the sides of the upper 2 or 3 rings of the trachea, and con- sting of minute closed vesicles containing a yellow-colored fluid, surrounded by dense plexus of capillaries, and connected together by areolar tissue. Its—

Isthmus,—connects the lower third of each lobe together, passing in front of the trachea. It is occasionallÿ absent.

Pyramid,—is a third lobe, which sometimes arises from the left lobe, or from the left upper border of the isthmus.

Levator Glandulæ Thyroideæ,—are muscular bands occasionally found extending from the body of the hyoid bone to the isthmus of the gland or its pyramid.

Name the Arteries of the Thyroid Gland. They are very large, anas-mose freely, and are the—

Superior Thyroid,—branch of the external carotid, arising therefrom below the greater cornu of the hyoid bone, and giving off the following branches, viz.—

Muscular.
Glandular.
Hyoid.
Superficial Descending.
Superior Laryngeal.
Crico-thyroid.

Middle Thyroid, *Artery of Neubauer*, or *Arteria Thyroidea Ima*,—is occasionally found arising from the innominate artery or directly from the arch of the aorta, passing upwards along the front of the trachea.

Inferior Thyroid, branch of the thyroid axis, gives off—

Laryngeal Branch.
Tracheal Branches.
Œsophageal Branches.
Ascending Cervical.

Enumerate the Veins and Nerves of the Thyroid Gland. The *Veins* form a plexus in front of the gland and the trachea, giving rise to the—

Superior Thyroid Vein. }
Middle Thyroid Vein. } open into the Internal Jugular Vein.

Inferior Thyroid Vein, opens into the Innominate Vein.

Nerves—are branches of the pneumogastric, and of the middle and inferior ganglia of the sympathetic.

THE THYMUS GLAND.

What is the Thymus Gland? It is a temporary organ, attaining its full size about the age of 2 years, then being about 2 inches long, 1½ inch broad, 3 lines thick, and weighing about half an ounce. It subsequently atrophies, and has almost disappeared at puberty. It is situated in the anterior mediastinum and the neck, behind the sternum and the sterno-hyoid and sterno-thyroid muscles, extending from the level of the 4th costal cartilage to the lower border of the thyroid gland. In the mediastinum it rests upon the pericardium, and is separated by the thoracic fascia from the arch of the aorta and the great vessels.

Describe its Structure. The Thymus gland consists of two lateral lobes (sometimes a third), together forming a pyramidal mass. It is surrounded by a fibrous capsule and is divided by *Trabeculæ* into primary and secondary lobules, which consist of meshes of delicate retiform tissue closely packed with lymph-corpuscles, and pervaded with capillaries. The so-called *Central Cavity* and *Primitive Linear Tube*, are deceptive appearances of the multiplying cells in the interior of the gland.

Name its Vessels and Nerves. The Thymus—

Arteries,—are derived from the internal mammary, superior and inferior thyroid, subclavian and carotid. They ramify on the surface of each lobule, having smaller twigs converging toward the centre.

Veins,—open into the left innominate and the thyroid.

Lymphatics,—consist of intralobular and interlobular plexuses, and open into the anterior mediastinal glands.

Nerves,—are very minute and derived from the pneumogastric and the sympathetic.

THE SUPRA-RENAL CAPSULES.

What are the Supra-Renal Capsules? They are two small, crescentic-shaped bodies, situated one on each kidney. Each presents a small fissure or *Hilum* anteriorly, from which its vein emerges, and consists of a—

Fibrous Capsule,—which is very thin, closely adherent, and sends numerous septa inwards.

Cortical Substance,—composed of columnar and rounded cells, held together in layers by a fibrous stroma.

Medullary Substance,—is darker than the cortical portion, and pulpy. Consists of cells in groups, supported by a delicate stroma, and believed by some anatomists to be prolonged into nerve fibres.

What are their Relations? Their bases rest on the upper front parts of the kidneys, their posterior surfaces on the crura of the diaphragm, about the level of the 10th dorsal vertebra. The—

Anterior Surface,—of the right capsule is covered by the liver; that of the left one by the spleen and pancreas.

Superior Surface,—of each is in relation internally with the great splanchnic nerve and semilunar ganglion.

Name their Vessels and Nerves. The *Lymphatics* of these bodies open into the lumbar glands, but are very imperfectly known. Their—

Arteries,—are the Supra-renal Branches of the aorta, renal, and inferior phrenic arteries, forming a dense capillary plexus in the cortical portion of the organ.

Veins,—of each open into a single trunk, the *Supra-renal Vein,* which on the right side of the body empties into the inferior vena cava, on the left side into the left renal vein.

Nerves,—are chiefly derived from the solar and renal plexuses, with some filaments from the phrenic and pneumogastric nerves, forming a complicated network in the medullary substance of the organ, and having numerous small ganglia developed upon them.

THE ABDOMINAL CAVITY.

What is the Abdomen? An oval cavity, situated between the thorax above and the pelvis below, invested by peritoneum internally, and containing he—

Stomach.
Intestines.
Liver.
Gall-bladder.
Spleen.
Pancreas.
Kidneys and Ureters.
Supra-renal Capsules.
Bladder (when distended.)
Uterus (during pregnancy.)
Abdominal Aorta.
Inferior Vena Cava.
Receptaculum Chyli.
Thoracic Duct.
Solar Plexus, etc.

Name the Boundaries of the Abdomen. *Above,* it is bounded by the iaphragm;—*below,* by the brim of the pelvis;—*posteriorly,* by the vertebral olumn, and the fasciæ covering the psoæ and quadrati lumborum muscles;—*nteriorly and laterally,* by the transversalis fascia, the lower ribs, and the enter of the ilium.

What Openings are found in its Walls? They are the—

Opening for the Vena Cava,— in the diaphragm.

Aortic Opening,—behind the diaphragm, for the aorta, vena azygos minor, the thoracic duct, and occasionally the left sympathetic nerve.

Œsophageal Opening,—in the diaphragm, for the œsophagus, and the pneumogastric nerves.

Umbilical Opening,—in the anterior wall, transmitting the umbilical vessels in the fœtus, but obliterated after birth, leaving a puckered depression, the *Umbilicus.*

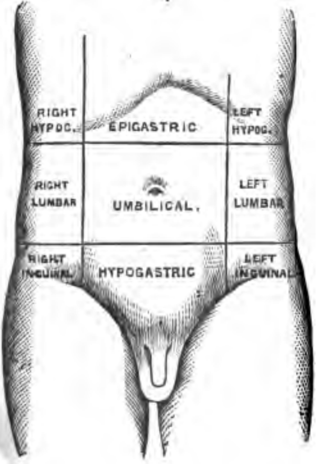
Internal Abdominal Ring,—on each side, half an inch above Poupart's ligament, for the passage of the spermatic cord in the male, and the round ligament of the uterus in the female.

Femoral or Crural Ring,—on each side, just below Poupart's ligament; for the passage of the femoral vessels. This opening is closed by the Septum Crurale. (See Femoral Hernia.)

Name the Regions of the Abdomen. The Abdomen is divided into 9 regions, by two horizontal lines,—one between the cartilages of the 9th ribs, another between the crests of the ilia,—and 2 vertical lines from the cartilages of the 8th ribs to the centre of Poupart's ligament. The 9 regions thus formed are named the—

Right Hypochondriac.	*Epigastric.*	*Left Hypochondriac.*
Right Lumbar.	*Umbilical.*	*Left Lumbar.*
Right Inguinal.	*Hypogastric.*	*Left Inguinal.*

FIG. 78.



What Parts are contained in each Region?

Right Hypochondriac Region,—contains the right lobe of the liver, gall-bladder, duodenum, hepatic flexure of the colon, upper part of the right kidney, and the right supra-renal capsule.

Epigastric Region,—contains the right two-thirds of the stomach, left lobe and lobus Spigelii of the liver, hepatic vessels, cœliac axis, solar plexus, pancreas, and parts of the aorta, inferior vena cava, vena azygos, and thoracic duct.

Left Hypochondriac Region,—contains the splenic end of the stomach, spleen, tail of the pancreas, splenic flexure of the colon, upper half of the left kidney and its supra-renal capsule.

Right Lumbar Region,—contains the ascending colon, lower half of the right kidney, and part of the small intestine.

Umbilical,—contains the transverse colon, transverse duodenum, part of the great omentum and mesentery, and part of the small intestine.

Left Lumbar Region,—contains the descending colon, lower half of the left kidney, and part of the small intestine.

Right Inguinal Region,—contains the right ureter, cæcum, appendix vermiformis, and the spermatic vessels of that side.

Hypogastric Region,—contains part of the small intestine, the bladder in children and when distended in adults, and the uterus during pregnancy.

Left Inguinal Region,—contains the left ureter and spermatic vessels, and the sigmoid flexure of the colon.

THE PERITONEUM.

What is the Peritoneum? A serous membrane, forming a closed sac, its *parietal layer* lining the walls of the abdomen and pelvis, its *visceral layer* being reflected more or less completely over all the abdominal and pelvic viscera. Its free surface is covered with squamous epithelium, and is smooth, moist, and shining Its attached surface is connected to the viscera and the parietes of the abdomen by the sub-peritoneal areolar tissue.

Is the Peritoneum always a closed sac? No! In the female it is continuous with the mucous lining of the Fallopian tubes, which at their free extremities open into its cavity.

Name the Divisions of the Peritoneum. The—

Greater Sac,—extends over the anterior two-thirds of the liver, behind and above the stomach, below, behind, and in front of the great omentum, and below the meso-colon.

Lesser Sac, or Cavity of the Great Omentum,—extends behind and below the liver and stomach, above the meso-colon, and within the great omentum.

What is the Foramen of Winslow? A constriction of the peritoneal cavity connecting the two sacs, situated behind the right free border of the gastro-hepatic or lesser omentum, and formed by the gastric and hepatic arteries as they curve around to the cœliac axis. Its boundaries are as follows, viz.—

Anteriorly,—the lesser omentum, containing the duodenum, hepatic artery, portal vein, and the ductus communis cholédochus.

Posteriorly,—the inferior vena cava, and the right crus of the diaphragm.

Superiorly,—the lobus Spigélii of the liver.

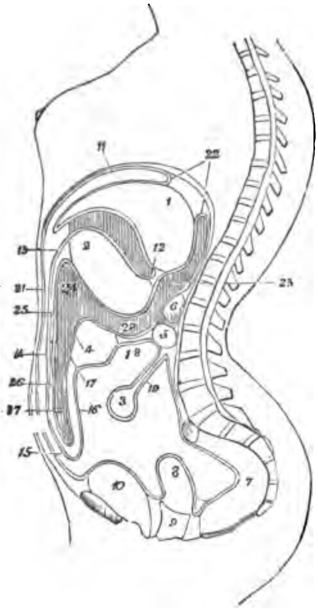
Inferiorly,—the hepatic artery, curving forwards from the cœliac axis

What passes through the Foramen of Winslow? Nothing.

What are the Omenta or Epiploa? They are folds of peritoneum connecting the stomach with other organs, and are 3 in number, namely, the—

Gastro-colic or Great Omentum,[14]—consists of four layers of peritoneum, the most anterior and posterior of which belong to the greater sac, the two internal to the lesser sac. The two anterior layers descend from the stomach and the spleen, over the small intestines, and then ascend as the posterior layers, to enclose the transverse colon.

FIG. 79.



Gastro-hepatic or Lesser Omentum,—consists of two layers of peritoneum, the upper belonging to the greater sac, the lower to the lesser sac. It extends from the transverse fissure of the liver to the lesser curvature of the stomach, and contains in its right free margin the—

Hepatic Artery.
Portal Vein.
Lymphatics.
Ductus Communis Cholédochus.
First part of the Duodenum.
Hepatic Plexus of Nerves.

Gastro-splenic Omentum,—connects the stomach with the spleen, and is continuous by its lower border with the great omentum. It contains the Splenic Vessels and the Vasa Brevia.

What are the Mesos or Mesenteries? Folds of peritoneum connecting the various parts of the intestinal canal (except the duodenum) to the abdominal walls. Each one contains the vessels of the part which it supports. They are the—

Mesentery proper.[19] *Meso-cæcum.* *Meso-colon.*[28] *Meso-rectum.*

What Ligaments are formed by the Peritoneum? They are 17 fol of peritoneum which support certain organs, viz.—

1 *Gastro-phrenic,*—from the stomach to the diaphragm.
4 *Hepatic*—the longitudinal, coronary, and 2 lateral ligaments of the liv
5 *Vesical,*—the false ligaments of the bladder.
6 *Uterine,*—2 vesico-uterine, 2 recto-uterine, and 2 lateral or broad ligments of the uterus.
1 *Splenic,*—the suspensory ligament of the spleen.

Name the Viscera covered by Peritoneum. They are the—

Liver[1] (almost wholly).
Stomach[2] (almost wholly).
Spleen.
Duodenum[5] (first part).
Small Intestine.[3]
Transverse Colon.[4]
Sigmoid Flexure.
Rectum (upper ⅓).
Ovaries.
Uterus.[8]

Name the Viscera partially invested by Peritoneum. The—

Duodenum[5] (descending and transverse portions).
Cæcum.
Ascending Colon.
Descending Colon.
Rectum[7] (middle third).
Vagina[9] (upper part).
Bladder[10] (posterior wall).

What Viscera have no Peritoneal Investment? The—

Rectum[7] (lower third).
Bladder[10] (neck, base and anterior surface).
Pancreas.[6]
Kidneys.
Supra-renal Capsules.
Vagina[9] (lower part).

What are the Appendices Epiploicæ? Pouches of peritoneum situated along the colon and upper third of the rectum, and filled with fat. They are chiefly found along the transverse colon.

A Demonstration of the Peritoneum is best made with a large bag of mosquito-netting, sewn up along all four sides, and having a central slit to represent the incision usually made in the laparotomy operation. Sponges of various sizes will represent the various organs, and may be pushed into folds of the bag and tied in by string, wholly covered or partially covered, as the case may be, for each. Professor Pancoast used this method of demonstration in his lectures, making the subject perfectly clear to many who never understood it before.

ORGANS OF VOICE AND RESPIRATION.

THE LARYNX.

What is the Larynx? A musculo-membranous-cartilaginous box placed between the trachea and the base of the tongue, and constituting the essential organ of voice.

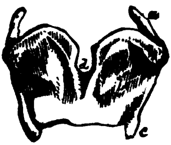
Name its Cartilages. They are nine in number, 3 single and 3 in pairs, iz.—

Thyroid Cartilage.
Cricoid Cartilage.
Epiglottis.
2 Arytenoid Cartilages.
2 Cuneiform Cartilages.
2 Cornicula Laryngis.

Describe the Thyroid Cartilage. The Thyroid or shield-like cartilage consists of two *Alæ* or wings,[b] united in front at an acute angle, the highest portion of its front being called the *Pomum Adami*, Adam's apple. Its—

Inner Surface,—gives attachment to the true and false vocal cords, the epiglottis, thyro-arytenoid and thyro-epiglottidean muscles, and the thyro-epiglottic ligament.

FIG. 80.



Outer Surface,—affords attachment to the sterno-thyroid, thyro-hyoid and inferior constrictor muscles; the first two being attached along its oblique ridge.

Upper Border,—is curved irregularly, and gives attachment to thė thyro-hyoid membrane.

Lower Border,—gives attachment to the crico-thyroid membrane in the median line and on each side to the crico-thyroid muscle.

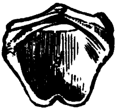
Posterior Border of each wing ends above and below in *Cornua* (horns), and gives attachment to the stylo- and palato-pharyngeus muscles.

Superior Cornu of each side affords attachment to the thyro-hyoid ligament.

Inferior Cornu of each side articulates with the cricoid cartilage by a small oval facet. (See *a* and *c*, Fig. 80.)

Describe the Cricoid Cartilage. The Cricoid, or ring-like cartilage, is placed below the thyroid, with its narrow part to the front. It has on each side *2 Articular Facets*, one on the upper margin posteriorly for the arytenoid cartilage, and one near the lower margin for the inferior cornu of the thyroid cartilage. Its—

FIG. 81.



Outer Borders,—give attachment to the crico-arytenoideus posticus muscle, and the longitudinal fibres of the œsophagus.

Upper Border,—affords attachment to the crico-thyroid membrane and the crico-arytenoidei laterales muscles.

Lower Border,—is connected to the upper ring of the trachea by fibrous membrane.

Describe the Arytenoid Cartilages. The Arytenoid, or pitcher-like cartilages, are 2 in number, pyramidal-shaped, and situated on the upper margin of the cricoid cartilage posteriorly, closing in the back of the larynx. Each cartilage has 3 surfaces, 2 angles, a base and an apex. The—

FIG. 82.

Anterior Surface,—gives attachment to the false vocal chord, and the thyro-arytenoideus muscle.

Anterior Angle,—gives attachment to the true vocal chord and the thyro-arytenoideus muscle.

Posterior Surface,—has attached to it the arytenoideus.

Posterior Angle,—gives attachment to the crico-arytenoideus lateralis and posticus muscles.

Internal Surfaces of each look towards each other.

Base,—has a facet for articulation with the cricoid.

Apex,—articulates with the corniculum laryngis.

What are the Cornicula Laryngis? They are 2 small cartilaginous nodules attached to the apices of the arytenoid cartilages, and are also called the *Cartilages of Santorini.* To them are attached the aryteno-epiglottidean folds.

What are the Cuneiform Cartilages? The Cuneiform, or *Cartilages of Wrisberg,* are 2 rods of yellow elastic cartilage contained in the free borders of the aryteno-epiglottidean folds.

Describe the Epiglottis. The Epiglottis is a cartilaginous lid for the larynx. It is leaf-shaped, situated behind the base of the tongue, and attached by its *apex* to the posterior surface of the thyroid cartilage, just below the median notch. Its—

Base,—is free, and curves over the base of the tongue.

Apex,—is connected to the receding angle of the thyroid cartilage by the thyro-epiglottidean ligament.

Anterior Surface,—is attached to the hyoid bone by the hyo-epiglottic ligament, and to the tongue by 3 glosso-epiglottidean folds.

Posterior Surface,—covers the superior aperture of the larynx when food passes through the pharynx.

Lateral Margins,—are connected to the arytenoid cartilages by the aryteno-epiglottidean folds.

Name the Ligaments of the Larynx. They are 19 in number,—3 extrinsic ligaments, connecting the larynx to the hyoid bone; and 16 intrinsic, binding its several cartilages together, viz.—

Extrinsic Ligaments (3), are the—

Thyro-hyoid Membrane, bounded laterally by—

2 Lateral Thyro-hyoid Ligaments, each contain a nodule of cartilage, the *Cartilago Triticea.*

Intrinsic Ligaments (16) are the—

Crico-thyroid Membrane.
2 Crico-thyroid Capsular Ligaments.
2 Crico-arytenoid Ligaments.
2 Crico-arytenoid Capsular Ligaments.
2 Superior Thyro-arytenoid (situated in the false vocal chords).
2 Inferior Thyro-arytenoid (situated in the true vocal chords).
Hyo-epiglottic Ligament.
Thyro-epiglottic Ligament.
3 Glosso-epiglottic Folds.

Describe the Vocal Chords. They are in two sets, the—

Superior or False Vocal Chords,—containing the superior thyro-arytenoid ligaments,—extend from the angle of the thyroid cartilage around to the anterior surfaces of the arytenoids, and consist of two folds of mucous membrane, each having a free crescentic margin.

Inferior or True Vocal Chords,—containing the inferior thyro-arytenoid ligaments,—extend from the angle of the thyroid cartilage around to the anterior angles of the bases of the arytenoids, and consist of two thin layers of mucous membrane covering the ligaments named, each having the thyro-arytenoideus muscle external and parallel to it.

What is the Glottis? The Glottis or *Rima Glottidis* is a narrow chink or interval between the inferior vocal chords, formed by the projection into the cavity of the larynx of these chords and the thyro-arytenoidei muscles. Its greatest length is less than an inch, its greatest breadth about half an inch. Its form is a narrow fissure of varying size.

What is the Ventricle of the Larynx? An oval depression on each side of the larynx, between the true and false vocal chords, leading up to the sacculus laryngis by a narrow opening.

What is the Sacculus Laryngis? A blind pouch situated in each laryngeal wall at the level of the false vocal chord. It is of conical shape, and contains 60 or 70 small mucous glands which secrete a fluid for the lubrication of the true vocal chord. The sacculus is covered in by the aryteno-epiglottideus inferior muscle internally, and by the thyro-epiglottideus externally, both muscles compressing it to discharge its contents. The Sacculus Laryngis is also called the *Sinus of Morgagni*, and the lower part of the ventricle is sometimes named the *Sac of Hilton*.

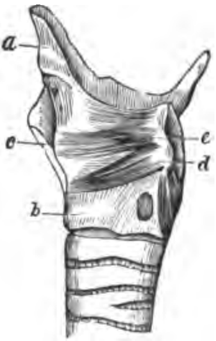
What class of Epithelium lines the Larynx? Its mucous membrane is covered with *Ciliated Epithelium* below the level of the superior vocal chords, extending in front as high as the centre of the epiglottis. Over the rest of the larynx is *Squamous Epithelium*.

Describe the Laryngeal Muscles. They are 4 in number on each side and one in the median line, viz.—

Crico-thyroid (2),—from the front and side of the cricoid cartilage,[b]—into the lower and inner border of the thyroid.[c] *Action*, to tilt the thyroid cartilage forwards, thus elongating and making tense the vocal chords. *Nerve*, superior laryngeal.

Crico-arytenoideus Posticus (2),—from the cricoid cartilage posteriorly,—into the posterior angle of the base of the arytenoid cartilage. *Action*, to rotate the arytenoids outwards and open the glottis, while keeping the vocal chords tense. *Nerve*, recurrent laryngeal.

FIG. 83.



Crico-arytenoideus Lateralis [d] (2),—from the upper lateral border of the cricoid cartilage,—into the posterior angle of the base of the arytenoid. *Action,* to rotate the arytenoids inwards and close the glottis. *Nerve,* recurrent laryngeal.

Thyro-arytenoideus [e] (2),—from the angle of the thyroid cartilage and the posterior surface of the crico-thyroid membrane,—into the base and anterior surface of the arytenoid. *Action,* to shorten and relax the vocal chords by approximating the cartilages, and to compress the sacculus laryngis. *Nerve,* recurrent laryngeal.

Arytenoideus (1),—from the posterior surface and outer border of one arytenoid cartilage,—into the corresponding parts of the opposite cartilage; having oblique and transverse fibres, and filling up the posterior concave surfaces of the arytenoid cartilages. *Action,* by approximating the arytenoids, to close the back part of the glottis. *Nerves,* superior and recurrent laryngeal.

A small fasciculus, called the *Kerato-cricoideus,* is sometimes found below the arytenoideus, extending from the cricoid cartilage to the inferior cornu of the thyroid. It occurs once in 5 cases, usually on one side only, but occasionally on both, and acts to fix the lower horn of the thyroid cartilage backwards and downwards.

Another small muscle is found frequently, though rarely described in the books, the *Triticeo-glossus.* It arises from the cartilaginous nodule in the lateral thyro-hyoid ligament, and passes forwards and upwards to enter the tongue along with the kerato-glossus muscle.

Describe the Muscles of the Epiglottis. They are 3 double muscles, as follows, viz.—

Thyro-epiglottideus (2),—from the inner surface of the thyroid cartilage,—into the margin of the epiglottis, and the aryteno-epiglottidean fold. *Action,* to depress the epiglottis, and compress the sacculus laryngis. *Nerve,* recurrent laryngeal.

Aryteno-epiglottideus Superior (2),—from the apex of the arytenoid cartilage,—into the aryteno-epiglottidean fold. *Action,* to constrict the superior aperture of the larynx. *Nerve,* recurrent laryngeal.

Aryteno-epiglottideus Inferior (2),—from the arytenoid cartilage just above the attachment of the superior vocal chord,—into the sacculus laryngis and the margin of the epiglottis. *Action*, to compress the sacculus laryngis. *Nerve*, recurrent laryngeal.

Name the Arteries and Veins of the Larynx. The—

Arteries,—are the Laryngeal Branches of the superior and inferior thyroid; and the Crico-thyroid Branches of the superior thyroid, which anastomose on the crico-thyroid membrane with their fellows of the opposite side.

Veins,—empty into the superior, middle and inferior thyroid veins.

Describe the Laryngeal Nerves. They are the Superior and Recurrent Laryngeal Branches of the pneumogastric, joined by filaments from the spinal accessory and the sympathetic. The—

Superior Laryngeal,—is the nerve of sensation. It enters the larynx by a hole in the thyro-hyoid membrane, and supplies the mucous membrane, and the crico-thyroid and arytenoideus muscles. It has the following branches, namely—

External Laryngeal. Internal Laryngeal.

Recurrent Laryngeal,—is the motor nerve. It winds from before backwards, around the subclavian artery on the right side, around the arch of the aorta on the left side, and is distributed to all the laryngeal muscles except the crico-thyroid,—giving off, in its course, cardiac, œsophageal, tracheal and pharnygeal filaments, and finally anastomosing with the superior laryngeal nerve.

THE TRACHEA AND BRONCHI.

What is the Trachea? A membrano-cartilaginous, cylindrical tube, about 4½ inches long, and ¾ to 1 inch in diameter, beginning at the lower border of the larynx,[2] opposite the 5th cervical vertebra, and ending opposite the 3d dorsal, by its bifurcation into the two bronchi. It is composed of a fibro-elastic membrane containing 16 to 20 imperfect cartilaginous rings, connected by muscular fibres. It is lined with mucous membrane covered with ciliated columnar epithelium, and furnished with glands. Its anterior surface is convex, its posterior surface flat.

State its Chief Relations in the Neck and Thorax.

Anteriorly,—it is covered from above downwards by the—

Isthmus of the Thyroid Gland.
Inferior Thyroid Veins.
Sterno-hyoid Muscle.
Sterno-thyroid Muscle.
Manubrium of the Sternum.
Thymus Gland.
Arch of the Aorta.
Innominate Artery.
Left Carotid Artery.
Deep Cardiac Plexus.

Posteriorly,—it is in relation with the—

Œsophagus.
Right Recurrent Laryngeal Nerve.

Laterally,—with the—

Common Carotid Arteries.	Recurrent Laryngeal Nerves.
Thyroid Gland.	Pleuræ.
Inferior Thyroid Arteries.	Pneumogastric Nerves.

Describe the Bronchi. They are two tubes similar in formation to the trachea, extending from its bifurcation into the lungs, where they divide and subdivide into bronchial tubes; losing their rings at the 2d or 3d subdivision, whence plates of cartilage extend in their walls to their minuter ramifications. The—

Right Bronchus,—is the widest, and the most horizontal, about 1 inch long, has 6 to 8 rings, and divides into 2 main divisions (though its lung has 3 lobes).

Left Bronchus,—is the narrowest and most oblique, nearly 2 inches long, has 9 to 12 rings, and divides into 3 main divisions (though its lung has 2 lobes).

What are the Relations of the Bronchi? Beginning opposite the 3d dorsal vertebra, the right bronchus enters the lung opposite the 4th dorsal vertebra, the left bronchus opposite the 5th. *The Right Bronchus* lies behind the vena cava superior and the right auricle of the heart, having the right pulmonary artery at first below, then anterior to it, and the vena azygos major arching over it from behind forwards. *The Left Bronchus* passes beneath the arch of the aorta and in front of its descending portion, also in front of the œsophagus and the thoracic duct, having the left pulmonary artery above and in front of it.

Name the Vessels and Nerves of the Trachea and Bronchi.

Arteries,—Tracheal Branches of the inferior thyroid (br. of thyroid axis), and the Bronchial (brs. of thoracic aorta).

Veins,—open into the thyroid plexus and the bronchial veins.

Lymphatics,—terminate in the mediastinal glands.

Nerves,—are derived from the pneumogastric and its recurrent laryngeal branch, also from the sympathetic.

THE LUNGS.

Describe the Lungs. The lungs are the two essential organs of respiration, contained in the cavity of the thorax, covered by the pleuræ, and characterized by lightness (sp. gr. 0.345 to 0.746), sponginess, elasticity, and crepitation when pressed. They weigh together about 42 ounces, the right lung being the heaviest by about 2 ounces. At birth their color is a pinkish-white, mottled as age advances by slate-colored patches, from the deposit of carbonaceous granules in the areolar tissue of the organ. *The Right Lung* is the largest and has 3 lobes; the *Left Lung* has 2 lobes. Each lung presents for examination an—

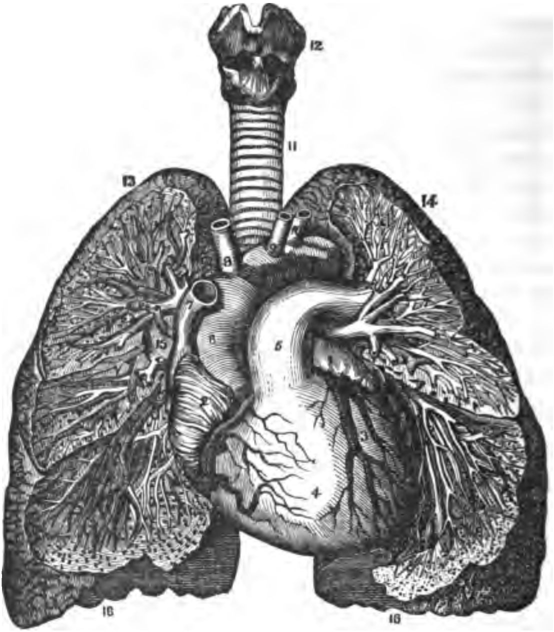
Apex,[13]—projecting into the neck about an inch above the 1st rib, where it is in relation with the subclavian artery and the scaleni muscles.

Base,[16]—is broad, concave, and directed obliquely downwards and backwards, resting on the upper convex surface of the diaphragm.

External Surface,—is convex, smooth, marked by the fissures, and corresponds in form to that of the thorax.

Inner Surface,—is concave, the left lung excavated for the heart, the surface forming part of the walls of the middle mediastinum.

FIG. 84.



Root,—is where the bronchi, vessels, and nerves enter the lung, b together by areolar tissue. In front of the root is the phrenic n behind it the pneumogastric nerve. Its chief structures are arrang the following manner :—

From before, backwards.	Pulmonary veins. Pulmonary artery.[5] Bronchus, etc.	V. A. B.

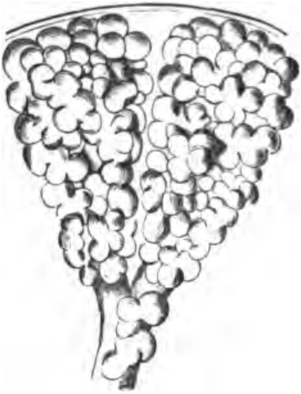
From above, downwards, on right side of body.	Bronchus, etc. Pulmonary artery. Pulmonary veins.	B. A. V.
From above, downwards, on left side of body.	Pulmonary artery. Bronchus, etc. Pulmonary veins.	A. B. V.

Describe the Structure of the Lung. The lung has a serous coat (the pleura); a sub-serous, elastic areolar tissue, investing the entire organ, and extending inwards between the lobules; and the parenchyma, or true lung-tissue, composed of—

Lobules,—each consisting of several air-cells or compartments, arranged around the termination of a bronchiole, and surrounded by 6 plexuses of pulmonary and bronchial arteries and veins, lymphatics and nerves. Each lobule is a miniature lung, pyramidal in form, with base outwards, and about $\frac{1}{12}$ inch in diameter.

Alveoli, or Air-cells,—are separated from each other by thin septa, are lined with pavement epithelium on a basement membrane, and vary in diameter from $\frac{1}{200}$ to $\frac{1}{70}$ inch. [See Fig. 85.]

FIG. 85.



Name the Vessels and Nerves of the Lungs. The lungs are nourished by the bronchial arteries, and supplied with blood for oxygenation by the pulmonary arteries.

Bronchial Arteries,—are derived from the thoracic aorta.

Pulmonary Arteries,—are derived from the right heart.

Bronchial Veins,—open on the right side into the vena azygos, on the left side into the superior intercostal vein.

Pulmonary Veins,—open by 4 large orifices into the left auricle of the heart, carrying oxygenated blood from the lungs to the heart.

Lymphatics,—terminate in the bronchial glands.

Nerves,—are branches from the pneumogastric and the sympathetic, forming the Anterior and Posterior Pulmonary Plexuses, from which filaments are distributed to each lobule.

THE PLEURÆ.

What are the Pleuræ? Two delicate serous sacs, one surrounding each lung and reflected over the pericardium, the diaphragm, and the inner surface of the thorax.

Where do the Pleuræ meet? For a short space behind the middle of the sternum, at the approximation of the anterior borders of the lungs.

What Names are given to the parts of the Pleuræ? The—

Pleura Pulmonalis, or Visceral Layer,—covers the lung, and invests that organ as far as its root.

Pleura Costalis, or Parietal Layer,—lines the inner surface of the parietes of the chest.

Cavity of the Pleura,—is the space between the two layers.

What is the Ligamentum Latum Pulmonis? The Broad Ligament of the Lung is a triangular fold or reflection of pleura, which descends from the root of the lung posteriorly to the upper surface of the diaphragm.

State the Differences between the Pleuræ. The right sac is shorter, wider, and reaches higher into the neck than the left.

Enumerate the Parts in Relation with the Left Pleura. Its—

Visceral Layer,—is in contact with the left lung.

Parietal Layer,—is in relation with the vertebral column, the ribs, intercostal muscles and vessels, the sternum, the left sympathetic nerve, the diaphragm, the arched portion of the subclavian artery, and the origin of the left carotid, the left pneumogastric, phrenic and cardiac nerves, the trachea, œsophagus, aorta and the pericardium.

What is the Mediastinum? It is the space between the two pleuræ in the median line of the thorax, extending from the sternum to the vertebral column, and containing all the thoracic viscera except the lungs.

Enumerate the Contents of each of its Divisions. The—

Anterior Mediastinum, contains the—

- Origins of the Sterno-hyoid and Sterno-thyroid Muscles.
- Triangularis Sterni Muscle.
- Left Internal Mammary Vessels.
- Thymus Gland.
- Lymphatics.

Middle Mediastinum, contains the—

- Heart and Pericardium.
- Ascending Aorta.
- Superior Vena Cava.
- Bifurcation of the Trachea.
- Pulmonary Arteries and Veins.
- Phrenic Nerves.

Posterior Mediastinum, contains the—

- Descending Aorta.
- Azygos Veins.
- Superior Intercostal Veins.
- Œsophagus.
- Pneumogastric Nerves.
- Splanchnic Nerves.
- Thoracic Duct.
- Lymphatic Glands.

THE URINARY ORGANS.

THE KIDNEYS.

Where are the Kidneys situated? Posteriorly in the abdomen, one on each side of the spinal column, behind the peritoneum, and extending from the level of the 11th rib to near the crest of the ileum. The right kidney is lower than the left.

State their Dimensions. Each one is about 4 inches by 2 by 1, and weighs from 4 to 6 oz.

Enumerate their Relations. The—

Anterior Surface of the Right Kidney,—is in relation with the right lobe of the liver, descending duodenum, and the ascending colon.

Anterior Surface of the Left Kidney,—with the tail of the pancreas, descending colon, and part of the spleen.

Posterior Surface,—with the crus of the diaphragm, 11th and 12th ribs, psoas magnus, quadratus lumborum, and the aponeurosis of the transversalis muscle.

Superior Extremity,—is capped by the supra-renal capsule.

Describe the Hilum of the Kidney. The *Hilum* is a fissure on the inner or concave border, leading into the *Sinus* or cavity of the gland. It contains the—

Renal Vein,—in front.
Renal Artery,—next in order.
Ureter, or Excretory Duct,—behind and below.

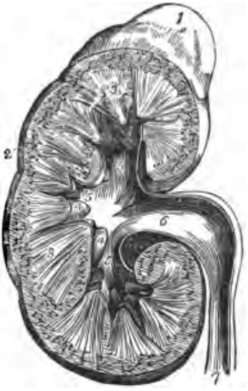
Describe the Kidney-structure. A vertical section presents the—

Pelvis or Sinus,[6]—the cavity, forming the beginning of the ureter[7] or excretory duct of the gland. Its divisions are the 3 *Infundibula*[5], and these are again divided into *Calices*[4] or pouches, into which open the orifices of the pyramids, 1000 orifices situated on each *Papilla*.

Medullary Substance,[8]—consists chiefly of the tubes of Bellini and Henle, arranged in *Pyramids of Malpighi*, whose apices project into the calices of the pelvis.

Cortical Substance,[2]—forms the surface of the gland, and consists of uriniferous tubules (straight and convoluted), Malpighian bodies, blood-vessels, nerves, lymphatics, connective tissue, and a granular matrix. It is of a red color, and is prolonged down to the pelvis between the pyramids, these prolongations being named the *Columns of Bertin*.

FIG. 86.



Describe the Tubuli Uriniferi. The uriniferous tubes begin at the Malpighian corpuscles in the Capsules of Müller, and end at the orifices on the surfaces of the papillæ. Their various portions are the—

Convoluted Tubes of Ferrein,—in the cortical substance.

Looped Tubes of Henle,—descending from the former and ascending into the next mentioned.

Straight Tubes of Bellini,—in the medullary substance, arranged in pyramids, the *Pyramids of Malpighi.*

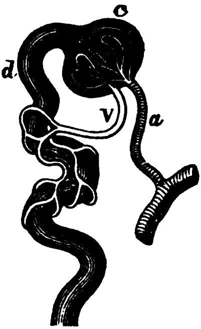
What are the Pyramids of Ferrein? They are pyramidal arrangements of the tubes of Ferrein at the bases of the pyramids of Malpighi.

What are the Malpighian Bodies? They are small red bodies found in the cortical substance, each formed by the dilated extremity of a tube of Ferrein, about the $\frac{1}{120}$ inch in diameter, and consisting of the—

Malpighian Tuft,—a tuft of capillary vessels, the termination of some branches of the renal artery^a and vein.^{v}

Capsule of Müller,^{c}—the dilated extremity of a tube of Ferrein,^{d} investing the Malpighian tuft probably by two layers, similar to the pleural investment of the lungs.

FIG. 87.



How is the Kidney invested? By a dense fibrous Capsule, which is continued inwards at the hilum, to line the sides of the sinus and form sheaths around the vessels. The kidney is also surrounded by a large quantity of fat.

Enumerate the various Divisions of the Renal Vessels. They are all derived from the Renal Artery and the Renal Vein, but in their course have received different names, as follows, viz.—

Renal Artery,—branch of the abdominal aorta. Divides into the—

Primary Branches, 4 or 5,—arising just external to the hilum, again subdivide and enter in the columns of Bertin as the Arteriæ Propriæ Renales, which form—

Arterial Arches,—over the bases of the pyramids, and divide into ascending and descending branches.

Interlobular Arteries, or *Ascending Branches*,—supply the cortical substance, and end in the Stars of Verheyen. (See next page.)

Arteriolæ Rectæ, or *Descending Branches*,—supply the medullary pyramids, ending in venous plexuses therein.

Afferent Vessels,—to the Malpighian bodies, from the ascending branches.

Malpighian Tufts,—are capillary plexuses within the Malpighian bodies. From them arise the—
Efferent Vessels,—whether arterial or venous, is undecided. They form
Venous Plexuses,—on the convoluted uriniferous tubes.
Stars of Verheyen,—are venous plexuses of stellate form, situated on the surface of the kidney, beneath its capsule, joining to form the—
Interlobular Veins,—from the cortical portion; which with the
Venæ Rectæ,—from the medullary pyramids, making
Venous Arches,—over the bases of the pyramids, finally meet in the—
Venæ Propriæ Renales,—and they end in the
Renal Vein,—which empties into the inferior vena cava.

Whence are the Nerves of the Kidney derived? From the Renal Plexus, which is formed by filaments from the solar plexus and the lesser planchnic nerve.

THE URETERS.

What is the Ureter? The excretory duct of the kidney, forming, by its pper expanded portion, the cavity of that gland. It is a musculo-membraous tube, 16 to 18 inches long, as large as a small goose-quill; and ends t the base of the bladder, into which it opens obliquely by a constricted rifice, about 2 inches from the orifice of its fellow. The ureter commences n the—

Calices,—7 to 13 small tubes, embracing the papillæ of the kidney, and joining to form the—
Infundibula,—3 or 4 in number, which unite in the—
Pelvis,—a funnel-shaped dilatation of the upper portion of the ureter.

Describe its Course. It descends obliquely inwards along the posterior all of the abdomen, enters the posterior false ligament of the bladder in the ale, and that of the uterus in the female, through which it passes forwards nd inwards to the posterior angle of the trigone vesicæ, lying between e muscular and mucous coats of the bladder, for about three-fourths an inch.

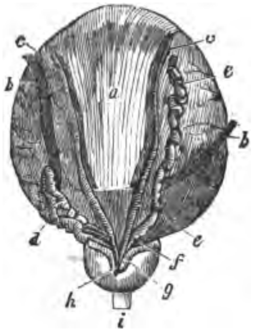
What are its Relations? It lies upon the psoas muscle, behind the perineum and below the spermatic vessels, over the common iliac or the external ac artery, behind the ileum on the right side, behind the sigmoid flexure the left. The right ureter lies close to the outer side of the inferior na cava.

Describe its Structure. The ureter has 3 coats—a fibrous, a muscular, d a mucous; the epithelium of the mucous coat is different from that the urethra, the bladder, or the uriniferous tubes, being spheroidal in ape.

THE BLADDER.

What is the Bladder? It is the urinary reservoir, a musculo-membranous sac, situated in the anterior portion of the pelvis, behind the pubes. When moderately distended it measures about 5 by 3 inches, and holds about a pint. Its—

FIG. 88.



Summit,—is connected to the umbilicus by the *Urachus* and the obliterated Hypogastric Arteries of the fœtus, forming three fibrous cords, the Superior Ligament of the bladder.

Body,—is in relation in front with the triangular ligament, the symphysis pubis, and the internal obturator muscles,—behind it is covered by peritoneum, and is in relation with the rectum in the male, with the uterus and upper part of the vagina in the female. Each side is crossed obliquely by the obliterated hypogastric artery and the vas deferens,[c] the first passing from below forwards, the latter from below backwards.

Fundus or Base,—rests on the second portion of the rectum in the male, on the lower part of the cervix uteri and adherent to the anterior wall of the vagina in the female. It is partly covered by peritoneum.

Cervix or Neck,—is constricted and continuous with the urethra.[i] It is surrounded in the male by the prostate gland,[h] and is directed downwards and forwards.

Name the Ligaments of the Bladder. They number 10, of which 5 are true ligaments, and 5 are false, the latter being folds of peritoneum. They are named as follows,—

True Ligaments.	*False Ligaments.*
2 Anterior (pubo-prostatic).	2 Posterior.
2 Lateral.	2 Lateral.
Superior (the Urachus, etc.).	Superior.

What is the Urachus? It is the obliterated remains of a canal, which in the embryo connects the bladder with the allantois. It is situated between the two obliterated hypogastric arteries, and with them forms the superior ligament of the bladder, connecting the summit of that organ with the umbilicus.

What is the Trigonum Vesicæ? ([7], Fig. 89.) The Vesical Trigone is a triangular space, of pale color, at the base of the bladder interiorly, characterized by its smooth surface and the intimate adhesion between its mucous and muscular coats. Its boundaries are—

In Front,—the urethral opening.

Posteriorly,—a line connecting the orifices [8] of the ureters.

Laterally,—two ridges of mucous membrane, which extend from the urethral orifice back to the orifices of the ureters.

What is the Uvula Vesicæ? ([4], Fig. 89.) A small elevation of mucous membrane projecting from the floor of the bladder into the urethral orifice. It is said to be lifted by the anterior fibres of the levator ani muscle.

Describe the Structure of the Bladder. It has a partial peritoneal investment, and its walls are composed of 3 coats,—a muscular, a cellular, and a mucous. The—

Muscular Coat,—consists of 5 sets of fibres, as follows,—
- External and Internal Longitudinal fibres.
- Intermediate Circular fibres, forming a *Sphincter Vesicæ* at the neck of the bladder.
- Transverse fibres, connecting the orifices of the ureters.
- Muscles of the Ureters, connecting their orifices with the middle lobe of the prostate gland.

Cellular Coat,—connects the other two coats together, and is closely attached to the mucous coat.

Mucous Coat,—is covered with epithelium intermediate in form between the columnar and the squamous; is loosely connected to the muscular coat, except at the trigone vesicale and the uvula vesicæ, where it is closely adherent.

What Nerves supply the Bladder? Branches from the hypogastric plexus supply its upper part,—from the sacral plexus its base and neck.

THE MALE URETHRA.

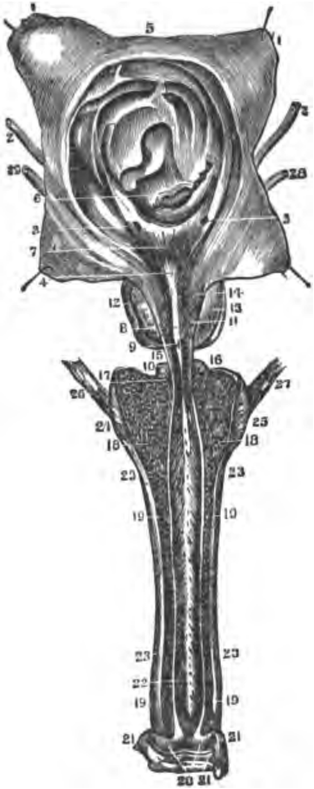
What is the Urethra? It is the urinary canal from the neck of the bladder to the meatus urinarius; in the male it is chiefly within the penis, and from 8 to 9 inches in length.

Enumerate its Divisions. The male urethra is divided into 3 parts,—the prostatic, membranous and spongy.

Describe the Prostatic portion of the Urethra.[14] It is that part of the canal which pierces the prostate gland,[12] is about 1¼ inch in length, of spindle-shape, and is the widest and most dilatable part of the urethra. Its floor presents the—

Veru Montanum, or Caput Gallinaginis,[8]—an elevation of the mucous membrane and its adjacent tissue, ¾ inch long, and supposed to contain muscular and erectile tissue.

FIG. 89.



Prostatic Sinus,[11]—one on each side of the veru montanum, containing the orifices of the prostatic ducts.

Sinus Pocularis, or Uterus Masculinus,[9]—a small cul-de-sac situated at the front part of the veru montanum. It extends for ¼ inch upwards and backwards into the prostate gland, beneath its middle lobe.

Orifices of the Seminal Ducts,—open on the margins of the sinus pocularis.

Describe the Membranous portion of the Urethra.[15] It is ¾ inch long above, and ½ inch along its floor, being that part of the canal lying between the layers of the triangular ligament of the perineum. Its walls are very thin, and almost destitute of erectile tissue. It is surrounded by the compressor urethræ muscle, and except the orifice, is the narrowest part of the urethral canal. On its sides are the—

Ducts of Cowper's Glands,[16]—on their way to open into the bulb of the urethra. (See p. 182.)

Describe the Spongy portion of the Urethra. It is about 6 inches long, and has two dilatations, one at each end, named respectively the Bulb and the Fossa Navicularis. The—

Bulb of the Urethra,[18]—is the upper end of the spongy portion, projects backwards for ¼ inch, and contains the orifices of Cowper's glands.

Fossa Navicularis,—is the lower dilatation of the urethra, and is situated within the glans penis.

Lacuna Magna,—the largest of several orifices of mucous follicles, situated on the roof of the fossa navicularis.

Glands of Littré,—are numerous mucous glands and follicles, opening into the urethral canal, their orifices being directed forwards.

Describe the Structure of the Urethra. It has 3 coats, a mucous, a muscular, and an erectile. The—

Mucous Coat,—is continuous with that of the whole urinary tract and the ducts of the glands opening therein. Its epithelium is columnar, except in the fossa navicularis, where it is squamous.

Muscular Coat,—consists of a layer of longitudinal fibres of the unstriped variety. [For the voluntary muscles of the urethra, see the Compressor Urethræ and Accelerator Urinæ, page 84.]

Erectile Coat,—is the corpus spongiosum of the penis, and a thin layer continued therefrom around the membranous and prostatic portions.

THE FEMALE URETHRA.

Enumerate the Characteristics of the Female Urethra. It is about 1½ inch long, imbedded in the anterior wall of the vagina, perforating the triangular ligament, and surrounded by the fibres of a compressor urethræ muscle. Its diameter is about ¼ inch, but it is capable of considerable dilatation, being surrounded by softer structures than those around the male urethra.

THE MALE GENERATIVE ORGANS.

THE URETHRAL GLANDS.

Where is the Prostate Gland? It encircles the neck of the male bladder, its apex touching the deep perineal fascia, its under surface resting on the rectum. It is perforated by the urethra and the common seminal ducts, and its ducts open into the prostatic portion of the urethra.

State its Dimensions and Characteristics. It measures about 1½ inch by 1 inch by ¾ inch, weighs about ¾ oz., resembles a horse-chestnut in size and shape, and consists of three lobes, two being lateral and of equal size, the third or middle lobe being a small prominence situated in the notch between the lateral lobes.

Describe its Structure. The prostate gland is composed of glandular substance and muscular tissue, inclosed in a fibrous capsule.

How is it Held in Position? By the pubo-prostatic ligaments of the bladder, the posterior layer of the deep perineal fascia, and by the anterior portion of the levator-ani muscle.

Where are Cowper's Glands? They are situated between the two layers of the deep perineal fascia, one on each side of the membranous portion of the urethra, close behind the bulb, and inclosed by the transverse fibres of the compressor urethræ muscle.

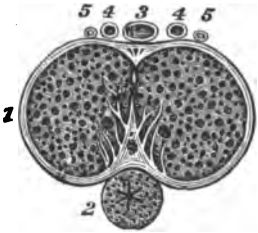
Where do their Ducts open? On the floor of the bulbous part of the spongy portion of the urethra, after traversing the wall of the urethra for about one inch, between its mucous and muscular coats.

THE PENIS.

Of what is the Penis composed? Of a mass of erectile tissue arranged in three compartments of cylindrical shape, each surrounded by a fibrous sheath which is prolonged inwards, forming numerous bands (trabeculæ), which divide the compartment into a number of spaces. The compartments are named the Corpora Cavernosa [1] and the Corpus Spongiosum,[2] the latter lying between and beneath the former, like the ramrod of a double-barreled gun.

Describe the Corpora Cavernosa. ([19], Fig. 89.) They lie side by side, forming the upper and lateral parts of the penis, are joined together along their anterior three-fourths, their posterior one-fourth forming the *Crura*, which arise from the tuberosities of the ischia and their descending rami, and meet beneath the symphysis pubis, forming two grooves, one above for the dorsal vessels[3], [4] and nerves,[5] the inferior one for the corpus spongiosum.[2]

FIG. 90.



Bulb of the Corpus Cavernosum,—is a slight enlargement on each crus, near its junction with its fellow.

Suspensory Ligament,—a fibrous membrane which connects the root of the organ to the symphysis pubis.

Septum Pectiniforme,—is a portion of the fibrous septum between the corpora cavernosa. This septum extends but two-thirds along the penis, and is wanting for its anterior third.

Describe the Corpus Spongiosum. It is an erectile tube lying in the inferior groove between the two corpora cavernosa, having within it the urethra, and being expanded at both ends to form the glans penis and the bulb. It is composed of trabecular (band-like) structure, derived from a fibrous sheath, and containing erectile tissue. The—

Bulb of the Corpus Spongiosum,—receives the urethra and is surrounded by the accelerator urinæ muscle.

Glans Penis,—is the external expansion of the corpus spongiosum, and covers by its base the ends of the two corpora cavernosa. Its base presents a rounded border, called the *Corona Glandis*, behind which is a deep sulcus, the *Cervix*.

Meatus Urinarius,—the external orifice of the urethra, is situated at the summit of the glans penis.

Prepuce,—a prolongation of the integument of the penis, covering or partly covering the glans penis.

Frenum Preputii,—a fold of mucous membrane lying along the raphé of the glans penis, and connecting the prepuce thereto.

Glands of Tyson,—small lenticular sebaceous glands opening on the corona and cervix of the glans, and secreting an odorous sebaceous matter, which is easily decomposed.

Of what does Erectile Tissue consist? Of an intricate venous plexus, supplied by afferent arteries and emptied by efferent veins. Such are the essential features of the erectile tissue of the penis, which is lodged in the interspaces between the trabeculæ of the fibrous structure.

What are the Helicine Arteries? They are peculiar vine-like arterial branches, which project in a convoluted manner into the venous plexuses in the posterior portion of the penis.

Enumerate the Vessels and Nerves of the Penis. Its—

Arteries,—are derived from the internal pudic, and are the—

Artery of the Bulb,—to the corpus spongiosum.

Artery of the Corpus Cavernosum,—to that structure.

Dorsal Artery of the Penis,—to the glans, prepuce and skin.

Veins,—empty into the Dorsal Vein of the Penis, the prostatic plexus and the pudic vein. The venous plexuses of the erectile tissue are very intricate, and remarkably developed.

Lymphatics,—the superficial terminate in the inguinal glands; the deep set joins the deep lymphatics of the pelvis.

Nerves,—are derived from the internal pudic nerve, and the hypogastric plexus of the sympathetic.

THE TESTES AND THEIR APPENDAGES.

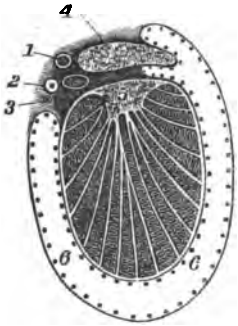
What are the Testes? The Testes or Testicles are the glandular organs which secrete the seminal fluid,—two oval bodies suspended obliquely in the scrotum by the spermatic cords, each measuring about an inch in diameter, and weighing ¾ oz. to an ounce.

What is the Scrotum? A cutaneous pouch, consisting of 2 layers—the integument and the *Dartos,*—the latter being a contractile vascular tunic, continuous with the superficial fascia of the thighs and perineum, and forming a septum in the scrotum between the two cavities for the testes.

Describe the Essential Coats of the Testis. They are 3 in number, as follows, viz.: the—

Tunica Vaginalis, the Serous Covering,—having a visceral layer (tunica vaginalis propria) and a parietal layer (tunica vaginalis reflexa). It was originally derived from the peritoneum, and the upper part being obliterated, it remained a closed sac. (See [6] Fig. 91.)

FIG. 91.



Tunica Albuginea, the Fibrous Covering,—formed of white fibrous tissue, and forming an incomplete vertical septum within the gland, the *Corpus Highmorianum* or *Mediastinum Testis*,[5] from which fibrous bands (trabeculæ) cross the gland, dividing its interior into spaces for the lobules of the organ.

Tunica Vasculosa, the Pia Mater Testis,—is the vascular tunic, lying beneath the tunica albuginea, and giving off numerous processes between the lobules.

Name the Coverings of the Testicle. From without inwards they are 6 in number, as follows, the—

(1) *Skin*,—of the scrotum, closely adherent to the dartos.

(2) *Dartos*,—or superficial fascia.

(3) *External Spermatic Fascia*, Intercolumnar Fascia,—derived from the margins of the external abdominal ring.

(4) *Cremasteric Fascia*,—derived from the lower border of the internal oblique muscle. [Called also the Cremaster Muscle.]

(5) *Internal Spermatic Fascia, or Fascia Propria*,—the infundibuliform process of the transversalis fascia.

(6) *Tunica Vaginalis*,[6]—originally a process of peritoneum. [Shown by dots in Fig. 91.]

Describe the Structure of the Testicle. The glandular structure is composed of small, convoluted tubes, the *Tubuli Seminiferi*,[3] (Fig. 92), which are collected into *Lobules*, about 300 in number, from which straight ducts, the *Vasa Recta*,[4] enter the mediastinum and form an ascending plexus of anastomosing tubes, the *Rete Testis*,[5] which gives off some 12 to 20 ducts, the *Vasa Efferentia*;[6] these perforate the tunica albuginea of the testis, and form a number of conical masses, the *Coni Vasculosi*,[7] which together constitute the *Globus Major*[7] of the Epididymis.[8]

What is the Epididymis?[8] It is an appendix to the testicle, lying along its posterior border, and consists of a single duct about 20 feet in length when unraveled, but which is wound upon itself so as to occupy a very small space. The—

Globus Major,[7]—is formed by the coni vasculosi, or efferent ducts of the testis, which therein open into the single duct which forms the epididymis.

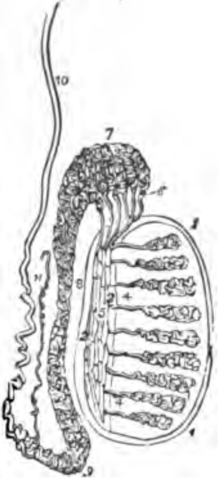
Body,[8]—is formed by the convolutions of the tube, held together by fine connective tissue, and is the central portion.

Globus Minor,[9]—the lower expanded portion, similarly formed, and connected to the testis by fibrous tissue.

Vasculum Aberrans,[11]—a narrow tube, sometimes found opening into the canal of the epididymis near its lower end, and ending in a blind extremity.

Hydatids of Morgagni,—small pedunculated bodies, found attached to the epididymis or to the upper end of the testicle. One of them is believed to be the remains of the duct of Müller. (See COMPEND OF PHYSIOLOGY, page 131.)

FIG. 92.



Describe the Vas Deferens.[10] It is the continuation of the epididymis, and is the excretory duct of the testicle. Beginning at the globus minor it ascends along the back of the spermatic cord to the external abdominal ring, where it enters the inguinal canal, and penetrates the abdominal cavity through the internal abdominal ring. Descending into the pelvis it passes between the bladder and the rectum, along the inner side of the vesicula seminalis, and at the base of the prostate gland it joins with the duct of the vesicula seminalis to form the ejaculatory duct. The vas deferens is about 2 feet long, and has a canal of only half a line in diameter. Its walls are very dense, making it feel like a piece of wire or whip-cord when grasped between the fingers. ([2] Fig. 91.)

Name the Arteries of the Testicle. The *Spermatic Artery*[1] supplies the gland itself; but the coverings of the testicle are supplied by the—

Superficial External Pudic, }
Deep External Pudic, } —branches of the Femoral.

Superficial Perineal,—br. of the Internal Pudic, from the Int. Iliac.

Cremasteric,—branch of the Epigastric, from the External Iliac.

Name the Nerves of the Testicle. They are the—

Ilio-inguinal, }
Ilio-hypogastric, } —branches of the Lumbar Plexus.

Superficial Perineal,—branch of the Internal Pudic nerve.

Inferior Pudendal,—branch of the Small Sciatic nerve.
Genital,—branch of the Genito-crural nerve.

Describe the Spermatic Cord. It extends from the internal abdominal ring to the globus minor of the epididymis, and is about 4 inches long. It consists of the following-named 10 structures, bound together by areolar tissue and invested by its coverings. These structures are the—

Vas Deferens. [2] Fig. 91.
Spermatic Artery.[1]
Cremasteric Artery.
Artery of the Vas Deferens.[3]
Spermatic Veins.
Spermatic Plexus of Nerves.
Branch of the Ilio-inguinal Nerve.
Branch of the Genito-crural Nerve.
Vasculum Aberrans.
Lymphatics.

What is the Pampiniform Plexus? A venous plexus formed by the spermatic veins and branches from the epididymis. It forms the chief mass of the spermatic cord, and unites into a single trunk, which on the right side empties into the inferior vena cava, on the left side into the left renal vein.

Describe the Vesiculæ Seminales. They are two sacculated, membranous pouches, serving as reservoirs for the semen, and are filled by the backing up of that fluid from the vasa deferentia. They are about 2½ inches in length, and are situated between the base of the bladder and the rectum. Their—

Ejaculatory Ducts,—one on each side, are formed by the junction of the vasa deferentia with the ducts of the vesiculæ seminales. They are about ¾ inch in length, and terminate in the prostatic portion of the urethra, by orifices on the sides of the veru montanum.

Describe the Descent of the Testes. In early fœtal life the testes are situated in the abdominal cavity, just below and in front of the kidneys, and are each connected to the dartos of the scrotum and the tissues about the inguinal canal by the 3 processes of a cord named the *Gubernaculum Testis*, which is supposed to gradually shorten itself and draw the testis down. At the beginning of the 5th month the descent begins; during the 7th month the testicle enters the inguinal canal, and ordinarily arrives in the scrotum by the end of the 8th month. A process of peritoneum is supposed to be carried down in front of the testis; which process, by obliteration of the canal, becomes a separate structure, the *Tunica Vaginalis*. The structures of the inguinal canal are also supposed to be brought down with the testicle, and to constitute some of its coverings.

FEMALE ORGANS OF GENERATION.

THE VULVA.

Enumerate the Organs comprised in the Vulva. They are the Mons Veneris, the Labia Majora, Labia Minora, Clitoris, Meatus Urinarius, and the Orifice of the Vagina.

Describe the Labia Majora. They are two prominent folds formed of skin, mucous membrane, areolar and dartoid tissues;—are joined together at the mons veneris, forming the *Anterior Commissure*, and also in front of the perineum, where they form the *Posterior Commissure.*

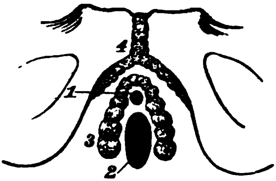
What are the Labia Minora? The Labia Minora or Nymphæ are two folds of mucous membrane, lost posteriorly in the labia majora, but anteriorly they embrace the clitoris, forming the *Prepuce* of that organ.

Describe the other Parts comprised in the Vulva. The—

Mons Veneris,—is the eminence in front of the pubes. It is formed of adipose tissue, and at puberty becomes covered with hair.

Clitoris,[4]—is situated beneath the anterior commissure, its *Glans* only appearing as a small rounded tubercle between the anterior extremities of the labia minora. It is a diminutive penis in all but the urethra, having a body, two crura, a glans, prepuce, suspensory ligament and muscles, the erectores clitoridis.

FIG. 93.



Bulbi Vestibuli,[3]—are two oblong masses extending from the clitoris along the sides of the vestibule, and consisting of a venous plexus surrounded by a fibrous membrane.

Pars Intermedia,—is a small venous plexus situated between the glans clitoridis and the bulbi vestibuli.

Vestibule,—is a triangular depression in front of the vaginal orifice, bounded laterally by the labia minora.

Meatus Urinarius,[1]—situated in the vestibule, about an inch below the clitoris, and close to the vaginal orifice.

Orifice of the Vagina,[2]—is surrounded by the sphincter vaginæ muscle, and in the virgin is sometimes partly closed by the hymen.

Hymen,—a fold of mucous membrane situated across the lower part of the vaginal orifice, of various shapes, but usually semilunar, the concavity upwards. It is frequently absent in virgins, and after sexual intercourse its rupture and cicatrization give rise to small eminences along the margin of the vaginal orifice, named the *Carunculæ Myrtiformes.*

Fourchette,—a small transverse fold just behind the posterior margin of the vaginal orifice.

Fossa Navicularis,—the space between the fourchette and the posterior commissure of the vulva.

Glands of Bartholine,—one on each side of the vaginal orifice, their ducts opening on the inner sides of the labia minora. They are the analogues of Cowper's glands in the male.

THE VAGINA.

Describe the Vagina. It is a curved canal extending from the vulva to the uterus, placed between the bladder and the rectum. Its length is about 4 inches along its anterior wall, an inch longer posteriorly, and its walls are usually in contact with each other. It is very dilatable, especially at its upper part.

Describe its Structure. The vaginal wall consists of a muscular coat externally, a layer of erectile tissue, and a mucous lining covered with squamous epithelium, and furnished with mucous glands and follicles. The—

Columns of the Vagina,—are two longitudinal raphés situated along its mucous surface, connected by numerous transverse ridges, or *Rugæ*.

What are the Relations of the Vagina? They are—

Anteriorly,—the urethra and the base of the bladder.

Posteriorly,—the anterior wall of the rectum, and the recto-uterine fold of peritoneum which forms *Douglas' cul-de-sac* behind its upper fourth.

Laterally,—are attached the broad ligaments of the uterus, the levatores ani muscles, and the recto-vesical fascia.

Superiorly,—it is attached to the cervix uteri above the os, and higher on the posterior wall than anteriorly.

THE UTERUS AND ITS APPENDAGES.

Where is the Uterus situated? In the pelvic cavity, between the bladder and the rectum, and above the vagina.

Describe the Uterus. It is a hollow, pear-shaped, muscular organ, measuring about 3 inches long, 2 inches broad, and 1 inch thick, flattened from before backwards, placed base upwards, and forming an angle with the vagina, which partially receives its cervix. The—

Fundus,*A*—is broad, convex, having walls ⅝ inch thick, and is covered by peritoneum.

Body,—is about 1⅝ inch long, walls ½ inch thick, flat anteriorly, convex posteriorly, concave laterally, and joined to the bladder by its lower anterior fourth. It is invested by peritoneum posteriorly, and in front for its upper three-fourths.

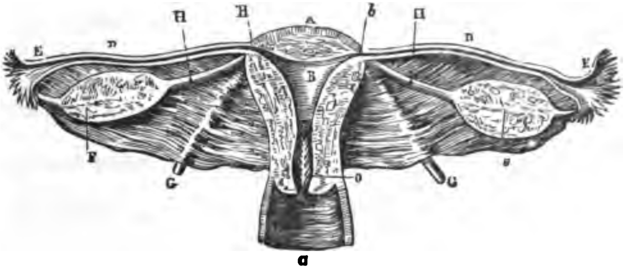
Cervix, or Neck,—is the lower constricted portion, about 1⅜ inch long, walls ¼ inch in thickness, and is embraced for ½ to ¾ inch by the upper extremity of the vagina.

Cavity of the Body,^{B}—is small and triangular, flattened from before backwards, about 1⅛ inch in length, and has two lateral *Cornua* above, and a constricted orifice—the *Os Internum Uteri*—at its lower angle, opening into the cavity of the cervix.

Cavity of the Cervix,—is spindle-shaped, about 1⅜ inch long, and presents on its inner surface transverse folds of mucous membrane proceeding from a longitudinal fold, giving an appearance named the Arbor Vitæ.^{o}

Os Uteri or Os Tincæ,—is a transverse orifice at the lower end of the cervical cavity, opening into the vagina, and having an anterior and a posterior lip.

FIG. 94.



Enumerate the Ligaments of the Uterus. The proper ligaments of the uterus are 6 in number,—2 Anterior, or *Utero-vesico-pubic,* 2 Posterior, or *Utero-recto-sacral,* and 2 Lateral, or *Broad Ligaments,* all composed of peritoneum. The—

Broad Ligaments,—pass from the sides of the uterus to the lateral walls of the pelvis, and form a septum across the pelvic cavity. They contain, between the two folds of peritoneum of which they are composed, the Fallopian tubes, the Ovaries, and the so-called Round Ligaments.

What are the Round Ligaments of the Uterus? They are two cords, composed of areolar and fibrous tissue, muscular fibres, vessels and nerves, extending one on each side, from the lateral aspects of the fundus uteri, through the inguinal canals, to the labia majora, where they are lost. Each ligament lies, for a part of its course, between the two layers of the broad ligament, and is covered by a process of peritoneum. (^{G} Fig. 94.)

Canal of Nuck,—is the extension of the above-named process of peritoneum into the inguinal canal. It exists in the fœtus, and is usually obliterated in the adult.

Describe the Uterine Structure. The uterine wall has 3 coats—peritoneal, muscular and mucous. Its—

Peritoneal or Serous Coat,—invests the body of the organ, excepting on its lower anterior fourth.

Muscular Coat,—constitutes the chief bulk of the uterus. It consists of bundles of unstriped muscular fibres, disposed in 3 layers interlaced together; circular fibres predominating in the cervix, longitudinal fibres in the body of the organ.

Mucous Coat,—is very thick, $\frac{1}{12}$ to $\frac{1}{8}$ inch, and closely adherent to the muscular tissue, having no basement layer of connective tissue. It is covered with ciliated columnar epithelium, and studded with mucous follicles and glands, which are most numerous in the cervix. The latter, when distended by their own secretions, form sacs, which Naboth mistook for human ova, and hence were named the *Ovules of Naboth.*

Enumerate the Uterine Vessels and Nerves. Its—

Arteries,—are the Uterine, from the anterior trunk of the external iliac, anastomosing with twigs from the Ovarian—(spermatic branch of the abdominal aorta).

Veins,—accompany the arteries, and in the impregnated state become sinuses. They end in the uterine plexuses.

Lymphatics,—those of the cervix end in the sacral and internal iliac glands, those of the fundus in the lumbar glands.

Nerves,—are derived from the inferior hypogastric and ovarian plexuses, and from the 3d and 4th sacral nerves.

Describe the Fallopian Tubes or Oviducts. They are two tubes, each about 5 inches in length, and $\frac{1}{16}$ inch in calibre, situated in the free margin of the broad ligament, and extending from the superior angles of the uterus ^{b} outwards, to terminate in free, trumpet-shaped ends, the *Fimbriated Extremities,*^{E} surrounded by fringe-like processes, the *Fimbriæ,* of which one or more are attached to the ovary of that side. Their structure is similar to that of the uterus, their mucous lining being continuous with the uterine mucous membrane and with the peritoneum. They open by one end into the uterus at its cornua, by the other end into the peritoneal cavity.

What are the Ovaries? Two oval bodies,^{F} of whitish color, situated in the broad ligament, behind and below the Fallopian tubes, one on each side of the uterus, to which they are attached by the *Ligaments of the Ovaries.*^{H}

They each measure about 1½ inch by ¾ by ⅓, and are invested by peritoneum, except posteriorly.

Describe the Structure of the Ovaries. They are composed of a vascular stroma containing the *Graafian Vesicles or Ovisacs*, in various stages of development, and are surrounded by a dense fibrous coat, the *Tunica Albuginea.*

Describe the Graafian Vesicles. They are the ovisacs containing the human ova, are very numerous (about 70,000 in each ovary), vary in diameter from $\frac{1}{80}$ to $\frac{1}{60}$ inch, but after puberty a few are found of from $\frac{1}{20}$ to $\frac{1}{6}$ inch or more. Each vesicle presents an—

External Coat,—of fibro-vascular structure.

Ovi-capsule,—or internal coat.

Membrana Granulosa,—a layer of nucleated cells, which at one point are heaped up around the ovum in a mature vesicle, forming the *Discus Proligerus.*

Fluid,—of transparent, albuminous character, containing the ovum in immature vesicles.

What is the Ovum? It is a spherical mass of protoplasm, about $\frac{1}{120}$ inch in diameter when fully developed. It presents a—

Vitelline Membrane,—also called the *Zona Pellucida,*—a colorless envelope, in which is contained the—

Vitellus or Yelk,—composed of granules in a fluid substance, one of which is called the—

Germinal Vesicle,—which contains a smaller body named the *Germinal Spot,* measuring about the $\frac{1}{3000}$ of an inch in diameter.

What is the Corpus Luteum? It is a puckered yellow spot in the substance of the ovary, produced as a result of the rupture of a Graafian vesicle and the discharge of an ovum, probably by the fatty degeneration of the extravasated blood. The—

True Corpus Luteum,—is that of pregnancy, and may increase in size, not disappearing until full term.

False Corpus Luteum,—occurs when impregnation has not taken place, and is absorbed in about three months.

What is the Pampiniform Plexus? A venous plexus near the ovary, formed by the veins of that organ.

Enumerate the Arteries and Nerves of the Ovaries. Their—

Arteries,—are the Ovarian (or Spermatic), from the aorta, which also supply the Fallopian tubes, anastomosing with the uterine arteries.

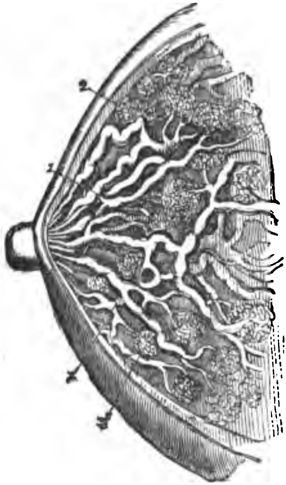
Nerves,—are derived from the Spermatic plexus.

What is the Parovarium? The Parovarium, or *Organ of Rosenmüller*, is a group of tubules, situated in the broad ligament, between the ovary and the Fallopian tube, and converging to a large duct, the *Duct of Gærtner*, which ramifies in the broad ligament, and descends along the side of the uterus. It is thought to be a remnant of the Wolffian Body of fœtal life. (See "Reproduction," in COMPEND OF PHYSIOLOGY.)

THE MAMMÆ.

Describe the Mammæ. The breasts are two hemispherical eminences, situated one on each latero-anterior aspect of the chest, extending from the sternum to the axilla, and from the 3d rib to the 7th. Each breast contains the *Mammary Gland* and is surmounted by the *Nipple*, around the base of which is a zone of colored cutaneous tissue, the *Areola*, pink in virgins, darker in women who have borne children. In the male the mammæ are rudimentary organs, but capable of development under special circumstances.

FIG. 95.



Describe the Structure of the Mammary Gland. It is a compound conglomerate gland, composed of 15 or 20 lobes and their ducts,[1] with a packing of areolar and adipose tissue, and enveloped by a fibrous capsule which forms septa between the lobes. Each lobe is made up of lobules,[2] and these again are formed by the aggregation of the *Acini* or terminal vesicles, in which the milk is secreted. The—

Tubuli Lactiferi or Tubuli Galactophori,[1]—are the excretory ducts of the lobes, one for each. They are formed by the junction of the ducts from each lobule, and converge towards the areola, beneath which they form *Ampullæ* or dilatations, and thence, piercing the nipple, open on its summit by separate orifices.

What is the Circulus Venosus? An anastomotic venous circle around the base of the nipple, from which larger veins run outwards and terminate in the axillary and internal mammary veins.

Name the Arteries of the Mammæ. They are derived from the Thoracic Branches of the axillary, the Intercostals, and the Internal Mammary rteries.

THE ORGANS OF SENSE.

THE SKIN AND ITS APPENDAGES.

Name the Divisions of the Skin. It is divided into the—

Epidermis, or Cuticle,
- *Superficial* Epithelial layers.
- *Rete Mucosum,* the pigmentary layers.

Derma, or *Cutis Vera,* the True Skin.
- *Papillary Layer,*[c] next below the rete, from which it is separated by a homogeneous basement membrane.
- *Corium,*[d] the deepest portion.

What Structures lie in and beneath the Skin? The

Sensitive Papillæ, containing the *Tactile Corpuscles* in very sensitive parts,—in the papillary layer of the Derma.

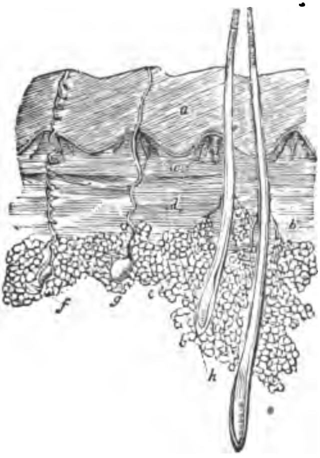
Sweat-glands.[f, g] *Hair-roots.*[h]
Sebaceous Glands.[i] *Fat Cells.*[e]
In the Sub-cutaneous Cellular Tissue.

Ducts of the Sweat-glands.
Hair-follicles,—into which most of the sebaceous ducts open.
Ducts of the Sebaceous Glands,—occasionally.
Perforate both the Derma and the Epidermis.

Describe the Structure of the Epidermis. It is an unorganized epithelial structure, having no vessels or nerves. The cells of which it is composed are agglutinated together in a laminated arrangement, are flat and dry on the surface, round and softer in the central portion, columnar and softest in the deepest layers. The lowest and softest layers are named the—

Rete Mucosum,—which is closely moulded upon the papillary layer of the derma, and contains pigment cells, to which the color of the skin is due.

FIG. 96.



Describe the Structure of the Derma. The true skin is a highly organized, tough yet elastic tissue, and serves to protect the parts beneath, to perform the functions of excretion and absorption, and as the chief seat of the sense of touch. It consists of fibro-areolar tissue, vessels and nerves. The—

Papillary Layer,—situated next to the rete mucosum, is covered with minute conical elevations (papillæ), $\frac{1}{100}$ inch high $\frac{1}{250}$ inch in diameter at their base, very numerous and arranged in parallel curved lines wherever sensibility is greatest. Each papilla contains a capillary loop or plexus, the termination of one or more sensory nerves,—and in highly sensitive parts, an oval-shaped body, the *Tactile Corpuscle*.

Corium,—the lower layer of the derma, is composed chiefly of interlacing bundles of white fibrous tissue, in which are mingled some yellow elastic fibres, also plain muscular fibres wherever hairs are found,—and lymphatic vessels, blood-vessels and nerves, in plexiform arrangement.

Describe the Nails. They are flat, horny structures, a modification of the epidermis, molded upon the derma at the dorsal surface of the terminal phalanges of both fingers and toes. Each nail is convex on its outward surface, and is imbedded by its *Root* into a fold of the skin. Its—

Matrix,—is that portion of the derma directly beneath the nail. It is covered with highly vascular papillæ. The—

Lunula,—is a white crescentic portion of the nail nearest to its root, produced by the diminution in number and size of the papillæ beneath.

What are the Hairs ? They are also a modified form of the epidermis, found over nearly the whole surface of the body, much varied in size and color. Each hair consists of a Root and a Shaft. The—

Root,—is lodged in an involution of the epidermis called the *Hair-follicle*, which sometimes extends into the subcutaneous cellular tissue. The root rests on a vascular papilla at the bottom or *Bulb* of the follicle, which supplies it with the material for its growth.

Shaft,—is the projecting portion of the hair. It consists of a medulla in the centre, next a fibrous portion, externally a cortex of thin, flat scales. The finest hairs have no medulla.

Point,—consists of the fibrous portion and the cortex, the medulla being wanting.

Where are the Sebaceous Glands most abundant ? In the scalp, the face, around the anus, and the apertures of the nose, mouth and external ear. The largest are the—

Meibomian Glands,—situated in the eyelids (see Fig. 104).

Describe the Sebaceous Glands. They are small, glandular bodies situated in the corium or in the subcutaneous cellular tissue over most of the body, but not in that of the palmar surface of the hands nor on the plantar surface of the feet. Each gland consists of a single sacculated duct, usually opening into a hair follicle, but sometimes ending on the surface of the integument.

Describe the Sweat-glands. Each gland consists of a single convoluted tube, situated usually in the subcutaneous cellular tissue, and opening on the surface of the integument by a spiral duct which pierces the derma and the epidermis. It is formed of two coats, an external fibro-cellular, which is continuous with the corium, and an epithelial lining, continuous with the epidermis.

State the probable number of Sweat-glands and their Evaporating area. They are estimated as varying, in different parts of the integument, from 417 to 2800 to the square inch, giving for the whole body a total of nearly two millions and a half, representing an evaporating surface of about 8 square inches.

ORGANS OF TASTE.

What are the special Organs of Taste? The *Taste-buds*, small, flask-shaped bodies, each about $\frac{1}{300}$ inch long, situated in the fungiform and circumvallate papillæ of the tongue. The seat of the sense of taste lies, however, in the mucous membrane covering the dorsum of the tongue, the upper portion of the pharynx, the soft palate and the fauces.

Name the special Nerves of Taste in the Tongue. The—

Chorda Tympani Branch of the Facial,—for its anterior two-thirds; perceiving saline, acid and styptic qualities (Flint).

Lingual Branch of the Glosso-pharyngeal,—for its posterior third; appreciating alkaline, metallic, sweet and bitter tastes (Flint).

What is Sapolini's view of the Chorda Tympani Nerve? From repeated dissections, Dr. Sapolini, of Milan, believes the chorda tympani to be a separate cranial nerve, having its proximal end in the so-called intermediary nerve of Wrisberg, originating in the floor of the 4th ventricle, and terminating in a dense plexus with the lingual branch of the 5th nerve, in the muscles of the tongue. He further concludes that the chorda tympani is the nerve governing the movements of the tongue in speech, and that the nerves of taste are the Lingual Branches of the 5th and 9th nerves.

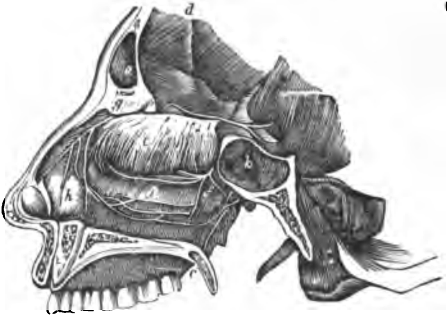
THE NOSE.

[For an osteological description of the Nasal Fossæ and Septum, see page 31.]

Where is the Organ of Smell situated? In the mucous lining of the upper portion of the nasal fossæ, which is the seat of distribution of the terminal filaments[c] of the *Olfactory Nerve*,[d] the special nerve of the sense of smell.

What is the Schneiderian Membrane? The Schneiderian or Pituitary Membrane is the mucous membrane of the nasal fossæ. It is continuous with the mucous lining of the pharynx, Eustachian tube, tympanum and mastoid cells; also with that of the frontal,[a] ethmoidal and sphenoidal sinuses,[b] the antrum, nasal duct, and the conjunctiva. It is covered with columnar epithelium, ciliated throughout most of its extent, provided with mucous glands, and in its deeper layer with the—

FIG. 97.



Olfactory Cells of Schultz,—spindle-shaped, epithelial structures grouped around and between the columnar epithelial cells, and joined together by their anastomosing processes, to form an intricate plexus on which the terminal fibres of the olfactory nerve are supposed to be distributed.

Name the Arteries of the Nose. They are the—

Lateralis Nasi,—branch of the facial, to the alæ of the nose.

Nasal of the Septum,—from the superior coronary artery, to the septum.

Nasal,—branches of the ophthalmic and infra-orbital, to the dorsum and sides of the nose.

Name the Arteries of the Nasal Fossæ. They are the—

Anterior and Posterior Ethmoidal,—from the ophthalmic.

Spheno-palatine,—branch of the internal maxillary.

Alveolar,—branch of the internal maxillary, to the antrum.

What Nerves supply the Nose? Branches from the facial, infra-orbital and infra-trochlear, and a filament from the nasal branch of the ophthalmic nerve.

What Nerves supply the Nasal Fossæ? They are the—

Olfactory or 1st Cranial,[e]—over the upper third of the septum nasi, and over the superior and middle turbinated bones.

Nasal Branch of the Ophthalmic,[g]—to the septum and outer walls.

Anterior Dental Branch of the Superior Maxillary,[j]—to the inferior meatus of the nose and the inferior turbinated bone.

Spheno-palatine Ganglion,—sends branches to the septum and the superior turbinated bone,—the *Superior Nasal Br.* to the same parts,—the *Naso-palatine* to the middle of the septum,—and the *Anterior Palatine* to the middle and lower turbinated bones.

THE EYE.

[For an osteological description of the Orbit, see page 29.]

What is the Visual Apparatus? It comprises the eyeballs and their appendages, which collect the luminous impressions,—and the optic nerves, which convey these impressions to the brain.

Describe the Eyeball. It is a spherical organ, situated in the anterior part of the orbital cavity, on a cushion of connective tissue and fat, where it is retained by its muscles, the optic nerve, the conjunctiva, etc., and protected in front by the eyelids and eyebrows. Projecting from its anterior surface is the segment of a smaller, transparent sphere, the Cornea. The eyeball has the following—

Diameters,—Antero-posterior, about .95 inch,—Transverse, .92 inch,—Vertical, .90 inch,—in the adult.

Anterior Pole,—is the geometric centre of the cornea.

Posterior Pole,—is the geometric centre of the fundus.

Optic Axis,—is an imaginary straight line connecting the poles.

Visual Axis,—an imaginary straight line from the yellow spot to the object, through the nodal point. It cuts the cornea above the optic axis, at an angle therewith of 3° to 7°, the *Visual Angle.*

Nodal Point,—the centre of curvature of the refracting surfaces.

Equatorial Plane,—an imaginary plane through the centre of the eyeball, perpendicular to the axis, dividing the ball or globe into the anterior and posterior hemispheres. The *Equator* is the line where this plane cuts the surface of the globe.

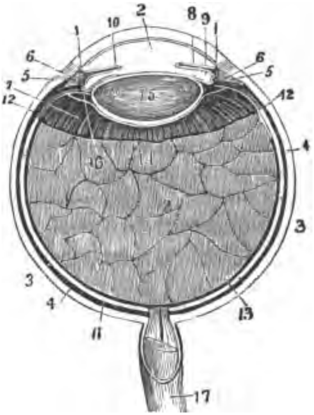
Meridional Planes,—are imaginary planes coinciding with the axis of the eyeball. *Meridians* are the lines where these planes intersect the surface of the globe.

Describe the Tunica Vaginalis Oculi. It is a fibrous capsule, surrounding the eyeball and the intra-orbital portion of the optic nerve; arising from the optic foramen and being lost anteriorly on the sclerotic. It consists of two layers (parietal and visceral) enclosing a lymph-space which communicates with the lymph-space between the sclerotic and choroid coats. The tendons of the ocular muscles pierce it. The—

Capsule of Bonnet,—is the portion of tunica vaginalis posterior to the point where the tendons pass through it. This part is loosely attached to the eyeball, which rotates in it.

Capsule of Tenon,—is the portion of the tunica vaginalis anterior to the passage of the tendons. [The whole capsule or Tunica Vaginalis is by many anatomists named the Capsule of Tenon.]

FIG. 98.



Name the Tunics of the Eyeball. They number 3, and are named as follows: the—

- *Sclerotic*[3] *and Cornea*,[1]—the external and protective tunic.
- *Uveal Tract*,—or vascular tunic, comprising the Choroid,[4] Ciliary body and the Iris,[8] within which is the—
- *Retina*,[11]—the innermost, nervous tunic.

Name the Humors of the Eyeball. They also number 3, as follows:—

- *Aqueous*,[2]—in the anterior[2] and middle[9] chambers.
- *Crystalline*,—forming the crystalline lens.[15]
- *Vitreous*,[18]—in the posterior chamber of the eyeball.

THE SCLEROTIC AND CORNEA.

Describe the Sclerotic. The Sclerotic or hard coat is the posterior five-sixths of the external tunic of the eyeball, the anterior one-sixth being the Cornea. Externally it is of a white color, covered anteriorly by the conjunctival mucous membrane, posteriorly being continuous with the sheath of the optic nerve. Internally its color is brown, and its surface marked by grooves for the ciliary nerves. The optic nerve pierces it posteriorly, also the long and short ciliary arteries, posterior ciliary veins and short ciliary nerves. In the equatorial region it is pierced obliquely by the venæ vorticosæ, and around the corneal border by the anterior ciliary arteries and veins. It is composed of connective tissue with elastic fibres, intermixed with pigment cells, and cells resembling the corneal corpuscles. It presents for consideration the following points, viz.:—

- *Thickness*,—$\frac{1}{25}$ inch posteriorly, $\frac{1}{60}$ inch anteriorly.
- *Lamina Fusca*,—a layer of very fine connective tissue, connecting the sclerotic with the outer surface of the choroid.
- *Lamina Cribosa*,—the posterior perforated portion of the sclerotic, which at this point is a thin, cribriform lamina. Its largest opening transmits the arteria centralis retinæ, and is named the *Porus Opticus*, or Optic Canal.
- *Sub-conjunctival Tissue*,—connects the conjunctiva with the outer surface of the sclerotic.

Sulcus,—a slight circular depression around the junction of the sclerotic with the cornea.

Arteries,—from the Ciliary, are few and in a coarse net-work, uniting at wide intervals, but forming, however, the—

Posterior Vascular Zone, or *Zone of Zinn,*—an arterial zone around the optic nerve entrance, formed by twigs of the short ciliary going to the optic nerve to anastomose with branches of the central artery of the retina, forming the only connection between the ciliary and retinal systems.

Anterior Vascular Zone,—around the cornea, formed by sub-conjunctival branches of anterior ciliary vessels.

Nerves,—none have been yet found in the sclerotic.

What is the Cornea? The Cornea, or horny body, is the anterior transparent projecting portion of the external tunic of the eyeball, forming about one-sixth thereof. It is set into the sclerotic as a watch-crystal into its case, is of ellipsoidal base, the transverse diameter being the longest, and slightly more convex vertically than horizontally. Its—

Thickness,—is $\frac{1}{28}$ inch at centre, $\frac{1}{22}$ inch at periphery.

Index of Refraction,—1.342.

Vessels,—none, except the peripheral zone, $\frac{1}{25}$ inch wide, formed of capillary loops from Episcleral branches of the anterior ciliary, which terminate at its circumference; so that it is practically a non-vascular structure.

Nerves,—are numerous; 20 or 30 twigs from the Ciliary nerves form an intricate plexus throughout its laminated substance.

Describe the Structure of the Cornea. It consists of five layers,—centrally the true corneal tissue, having in front an anterior elastic lamina and the conjunctival epithelium; behind, a posterior elastic lamina and the epithelial lining of the aqueous chamber. The—

Layer of Conjunctival Epithelium $\frac{1}{300}$ inch thick, consists of two or three layers of transparent nucleated cells.

Anterior Elastic Lamina, also named the *Anterior Limiting Layer,* the Membrane of Bowman or Membrane of Reichert,—is $\frac{1}{5000}$ to $\frac{1}{2000}$ inch thick, a firm, elastic and transparent homogeneous membrane, consisting of closely-interwoven fibrils, similar to those in the corneal tissue proper.

True Corneal Tissue,—$\frac{1}{25}$ inch thick, a transparent, fibrous structure, formed of five connective-tissue fibrillæ, united in bundles, and these in laminæ, between which is a semi-fluid cement, filled with *Corneal Corpuscles* and wandering cells.

Posterior Elastic Lamina, Membrane of Descemet, or Demours,—is, like the anterior elastic lamina, a structureless basement membrane, of extreme thinness, resisting the action of water, alcohol or acids; very brittle, eceedingly elastic, and curls up inwardly upon itself, when detached from the true cornea. At the corneal margin it breaks up into fibres, which are continuous with the ligamentum pectinatum of the iris.

Posterior Epithelial Layer,—a single layer of flattened, polygonal, transparent, nucleated cells, forming the endothelium of the membrane of Descemet or Demours, and the epithelial lining of the aqueous chamber.

THE UVEAL TRACT.

Describe the Choroid. It is the posterior portion of the middle tunic of the eyeball, $\frac{1}{300}$ to $\frac{1}{150}$ inch thick, and extends from the optic nerve entrance to the ora serrata, a little in front of the equator. It is highly vascular, of dark-brown color, connected to the sclerotic by the *Lamina Fusca*, terminates anteriorly in the *Ciliary Processes*, and is composed of four layers, as follows:—

Tunica Vasculosa,—externally, consists of the venæ vorticosæ and the larger arterial branches.

Membrana Ruyschiana, or Chorio-capillaris, the middle layer—consists of a fine capillary plexus, formed by the short ciliary vessels.

Limiting Membrane,—a structureless hyaline membrane, covering the inner surface of the capillary layer.

Pigmentary Layer, internally,—a single layer of hexagonal nucleated cells, loaded with pigment of a brown-black color, which is absent in albinos, and of slight amount in blondes. [Considered by many anatomists the 10th layer of the retina.]

Arteries of the Choroid,—are the short posterior ciliary, and recurrent branches from the long posterior and anterior ciliary. (See p. 105.)

Veins,[2]—unite into 4 or 6 Venæ Vorticosæ,[4] which pass out through the sclerotic near its equator.

Nerves,[3]—derived from 3d, 5th, and sympathetic, through the long and short ciliary nerves. (See p. 137.)

What are the Ciliary Processes? They are 70 or 80 folds, formed by the anterior prolongation of the middle and internal layers of the choroid on the inner surface of the ciliary muscle, being received into corresponding folds on the suspensory ligament of the lens. They are about $\frac{1}{10}$ inch in length, and form a curtain-like expansion behind the iris.

Describe the Ciliary Body.[5] It is the portion of the uveal tract between the choroid and the iris,[6] and consists of ciliary muscle covered by choroidal stroma and the ciliary processes. The—

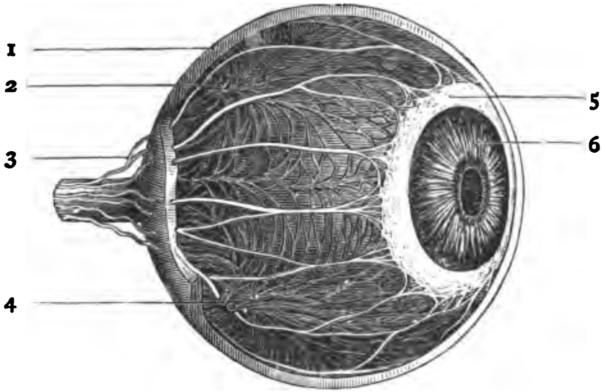
Ciliary Muscle or Muscle of Bowman,—is a ring of involuntary muscular fibres, supplied by the 3d nerve; is thickest anteriorly, thin posteriorly. Its fibres arise from the corneo-sclerotic junction, and pass backwards to be attached to the choroid in front of the retina. Consists of meridional fibres drawing the choroid forwards, and circular fibres which relax the zonula and permit the lens to become more convex, from its own elasticity.

Annular Muscle of Müller,—consists of separate circular bundles at the anterior internal angle of the ciliary body.

Circulus Arteriosus Major and *Minor*,—are arterial circles on the ciliary muscle, formed by branches of the long posterior ciliary and anterior ciliary arteries.

What is the Iris[6] **?** It is a perforated curtain, suspended in the aqueous humor behind the cornea and in front of the lens, and is the anterior portion of the middle tunic of the eyeball, being continuous with the ciliary muscle and the choroid coat. It is about $\frac{1}{6}$ inch wide, $\frac{1}{100}$ inch thick, and is composed of radiating and circular muscular fibres, a fibrous stroma and pigment cells, covered by a layer of irregular cells continuous with those of the membrane of Descemet. The—

FIG. 99.



Pupil,—is the central opening in the iris, situated a little to the nasal side of the centre, diameter $\frac{1}{12}$ to $\frac{1}{4}$ inch.

Ligamentum Pectinatum Iridis, or Dollinger's band,—is the suspensory ligament of the iris, connecting its ciliary margin with the corneo-sclerotic junction. It is formed of strong fibrous prolongations from the membrane of Descemet and the posterior surface of the cornea.

Fontana's Spaces,—are spaces between the prolongations which form the ligamentum pectinatum. In some animals, as the ox, they form regular canals.

Uvea, or Tapetum,—a layer of purple pigment-cells on the posterior surface of the iris, continuous with the pigment layer of the ciliary processes.

Sphincter Pupillæ,—a layer of circular muscular fibres around the pupillary margin, supplied by the 3d nerve.

Dilator Pupillæ,—radiating muscular fibres from the pupillary margin toward the ciliary border, supplied by fibres of the sympathetic, from the ciliary ganglion. [See p. 137.]

Membrana Pupillaris,—a vascular membrane which covers the pupil in the fœtus, disappearing about the eighth month,—occasionally permanent. It is nourished by the *Hyaloid Artery*, through the *Canal of Stilling* (described under the VITREOUS HUMOR).

Arteries,—are derived from the long and anterior Ciliary, forming the *Circulus Major Iridis* at the ciliary border, and the *Circulus Arteriosus Iridis Minor* near the pupillary margin.

Veins,—empty into those of the ciliary processes and the anterior ciliary veins

Sinus Circularis Iridis, Canal of Schlemm, or Canal of Fontana,—is a minute canal at the internal corneo-sclerotic junction, extending around the circumference of the attached border of the iris. It is lined by endothelium and encloses a venous plexus, receiving veins from the sclerotic and the ciliary plexus. It communicates with the chamber of the aqueous humor and with the anterior ciliary veins.

Nerves of the Iris,—are derived from the 3d, 5th and the sympathetic, through the long and short ciliary nerves. The 3d supplies the circular fibres, the sympathetic the radiating ones, the 5th being nerves of common sensation.

THE RETINA.

What is the Retina? It is the innermost or nervous tunic of the eye,—a delicate, grayish, transparent membrane, about $\frac{1}{75}$ of an inch thick at the fundus, $\frac{1}{200}$ inch at the anterior margin. It is formed by a membranous expansion of the optic nerve elements, and extends from the termination of that nerve nearly as far forwards as the ciliary processes, terminating in a jagged margin, the *Ora Serrata*, though its fibrous stroma is continued as the *Pars Ciliaris Retinæ* over the ciliary body. The Retina presents for examination the following points, viz., the—

Macula Lutea, or Yellow Spot,—situated on the retina, exactly in the visual axis; is an elevated oval spot where vision is very acute, the retina being very thin and full of nerve elements closely packed together at the expense of its connective tissue. No rods, no nerve-fibre layer here, but the cones and ganglion-cells are very numerous.

Fovea Centralis,—a depression at the centre of the macula lutea, $\frac{1}{125}$ to $\frac{1}{}$ inch in diameter, in which the sense of vision is most acute.

Optic Disc or Papilla,—the point where the optic nerve enters, the central artery of the retina piercing its centre. It lies about $\frac{1}{10}$ inch internal to and $\frac{1}{20}$ inch below the posterior pole of the eye, and is often called the *Blind Spot*, being the only part of the fundus oculi from which the power of vision is absent.

Pars Ciliaris Retinæ,—the part of the retinal stroma which is prolonged over the ciliary body. It is destitute of nerve-elements.

Arteries of the Retina,—arise from the Arteria Centralis Retinæ (br. of the ophthalmic), just behind the optic disc; run chiefly upwards and downwards, accompanied by veins, to terminate in capillary network. No vessels exist in the fovea centralis, and only the finest capillaries in the macula lutea.

Describe the Structure of the Retina. It is composed of nervous elements, blood-vessels, and modified connective tissue resembling the neuroglia of the brain, arranged in 9 or 10 layers, from within outwards, as follows, viz.—

Membrana Limitans Interna,—a perfectly transparent membrane, made up of the retinal connective tissue, and lining the inner surface of the retina (shown in the cut by the lowest line).

Optic Nerve Fibres,[1]—composed of the terminal fibres of the optic nerve radiating from the papilla in all directions. They consist of the axis-cylinder only.

Ganglionic Layer,[2]—a very thin layer of large ganglion cells, having large nuclei and nucleoli, with branching processes to the optic nerve fibres of next layer.

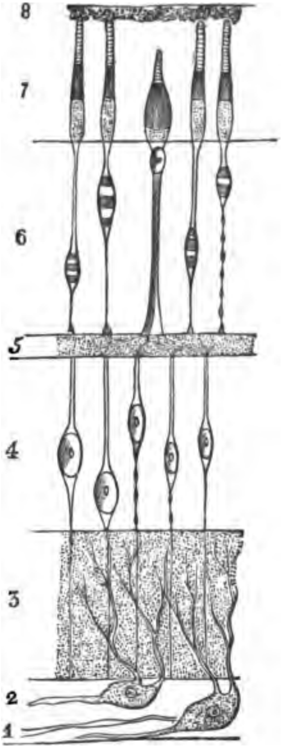
Internal Molecular Layer,[3]—fine granules intersected by finest nerve fibres and connective tissue elements.

Internal Granular Layer,[4]—small, round cells with large nuclei, their processes uniting with the ganglion cells.

External Molecular Layer,[5]—a very thin layer of fine granules and nerve-fibrillæ.

External Granular Layer,[6]—consists of ellipsoid cells, forming a nucleated enlargement of Jacob's membrane.

FIG. 100.



External Limiting Membrane,—a membranous expansion of radial connective tissue, perforated by foramina (shown in the cut by a line between [6] and [7]).

Rods and Cones, or Jacob's Membrane,[7]—the perceptive layer of the retina, composed of rods and cones closely packed together, like palisades, the termini, probably, of the optic nerve fibres.

[A tenth layer is described by some anatomists, the pigmentary layer of the choroid.[8] See *ante*, p. 200.]

Name the Essential Elements of the Retinal Structure.

PRINCIPAL ELEMENTS, are three, as follows, viz.—

Nerve-fibres,—which in the molecular layers break up into very delicate plexuses. In their course are found—

Nerve-cells,—ordinary bipolar or multipolar, and modified ones, the so-called granular layers of the retina.

Terminal Organs,—the rods and cones of Jacob.

SUBORDINATE ELEMENTS, are two, the—

Modified Connective Tissue,—of spongy nature.

Vessels,—blood-vessels and lymphatics.

THE HUMORS.

What is the Aqueous Humor? It is a clear, alkaline, serous fluid, composed of water 96.7, albumen 0.1, chloride of sodium and extractive matter 3.2, weighing 4 to 5 grains, and filling the anterior and posterior aqueous chambers, which communicate with each other when the pupil is dilated sufficiently to remove the pupillary margin of the iris from the surface of the lens. The—

Anterior Chamber of the Aqueous Humor,—has the cornea in front and the iris behind.

Posterior Chamber of the Aqueous Humor,—has the iris in front, the lens, zonula and ciliary body behind. [The existence of any such space is denied by many authorities.]

Describe the Crystalline Lens. It is a bi-convex, elastic, transparent body, enclosed in a capsule, held in place by a suspensory ligament, and situated between the posterior aqueous chamber and the chamber of the vitreous humor, immediately behind the pupil. Its posterior surface is the most convex and rests in the *Hyaloid Fossa* of the vitreous. Its—

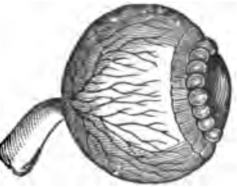
Dimensions and Weight,—diameter, about ⅜ inch,—axis about ¼ inch,—weight, 4 to 4½ grains,—index of refraction, 1.44.

Composition,—water 60, soluble albuminous matter 35, insoluble albuminous matter 2.5, fat and cholesterine 2 per cent.

Capsule,—is transparent, elastic, $\frac{1}{2000}$ inch thick anteriorly, $\frac{1}{6000}$ inch posteriorly; has a layer of flat cells between its anterior portion and the lens, which, after death, break down into a fluid, the *Liquor Morgagni.*

Zonula of Zinn, or Suspensory Ligament,—connects the capsule with the ciliary body. It is formed by a splitting of the hyaloid membrane into two layers, one going in front of the lens, the other behind. It is shown exaggerated in the cut.

FIG. 101.



Canal of Petit,—is a triangular space around the circumference of the lens, formed by the separation of the two portions of the suspensory ligament (shown inflated in the cut).

Processus Zonulæ,—are small radiating folds on the anterior surface of the suspensory ligament, which are received between the ciliary processes.

Describe the Structure of the Crystalline Lens. It consists of flattened hexagonal fibres, united laterally into lamellæ, by serrated edges, and curving around the borders of the organ. Its centre or *Nucleus* is unstratified, and denser than the surrounding portion or *Cortex*. It is unorganized, having no vessels or nerves, but receives its nutriment by imbibition from the uveal tract, and possibly from the other humors of the eye.

What is the Vitreous Humor? The Vitreous Humor or Hyaloid Body is an apparently structureless substance, of gelatinous consistence, consisting of water with a little albumen and salts, and containing cells, nuclei, and connective-tissue filaments. It has no vessels or nerves, and is situated in the posterior chamber of the eye, behind the lens, which it supports, as also the retina. The—

Canal of Stilling, Canal of Cloquet, or Hyaloid Canal,—traverses the vitreous humor antero-posteriorly, being the channel for the transmission in the fœtus of the *Hyaloid Artery* to the membrana pupillaris. [See *ante*, p. 202.]

Hyaloid Fossa,—a depression on the anterior surface of the vitreous, receiving the posterior convexity of the lens.

What is the Hyaloid Membrane? It is a delicate capsule investing the vitreous, and supposed to send delicate septa into the substance of that humor. It divides anteriorly into two layers, which enclose the Canal of Petit and the Lens, forming the suspensory ligament of the latter, or Zonula of Zinn. [See above.]

The foregoing is the view of most anatomists, but some assert that this membrane is identical with the internal limiting membrane of the retina, extending only to the ora serrata. [Henle, Iwanoff, etc.]

Others admit a hyaloid membrane surrounding the vitreous, but deny that it splits to enclose the lens, and assign but one layer to the suspensory ligament, namely, that in front of the Canal of Petit. [Gray, etc.]

Describe the Muscles of the Eyeball. They number 6, of which 4 are Recti and 2 Oblique, as follows:—

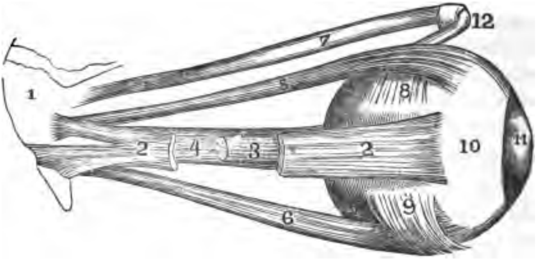
Rectus Superior,[5]—from the upper margin of the optic foramen and the sheath of the optic nerve,—into the sclerotic coat. *Action*, to rotate the eyeball upwards. *Nerve*, 3d cranial.

Rectus Inferior,[6]—from the ligament of Zinn,—into the sclerotic coat. *Action*, rotates the eyeball downwards. *Nerve*, 3d cranial.

Rectus Internus,[4]—from the ligament of Zinn,—into the sclerotic coat. *Action*, rotates the eyeball inwards. *Nerve*, 3d cranial.

Rectus Externus,[2]—by two heads, the upper from the outer margin of the optic foramen, the lower from the ligament of Zinn and a bony process at lower margin of the sphenoidal fissure,—into the sclerotic coat.[10] *Action*, to rotate the eyeball outwards. *Nerve*, 6th cranial, or abducens. Between the two heads of the external rectus pass the 3d, nasal branch of the 5th, and the 6th cranial nerves, and the ophthalmic vein.

FIG. 102.



Obliquus Superior,[7]—from about a line above the inner margin of the optic foramen, its tendon passing through a "pulley"[12] near the internal angular process of the frontal bone and thence beneath the rectus superior, —into the sclerotic coat, at right angles[8] to the insertion of the rectus superior. *Action*, to rotate the eyeball on its antero-posterior axis. *Nerve*, 4th cranial, or patheticus.

Obliquus Inferior,[9]—from the orbital plate of the superior maxillary,—into the sclerotic coat below the insertion of the external rectus and at right angles thereto. *Action*, to rotate the eye on its antero-posterior axis. *Nerve*, 3d cranial.

VESSELS AND NERVES OF THE EYE.

What Nerves supply the Muscles of the Eye? The—

3d Cranial, or Motor Oculi,—supplies the superior, inferior and internal recti, and the inferior oblique muscles.

4th Cranial, or Trochlear,—supplies the superior oblique muscle.

6th Cranial, or Abducens,—supplies the external rectus.

Describe the Arteries of the Eye. The Eye is supplied by the *Ophthalmic* and *Anterior Cerebral* branches of the internal carotid artery, and the *Infra-orbital* branch of the internal maxillary (from the external carotid). The—

OPHTHALMIC,—arises from the cavernous portion of the Internal Carotid, and enters the optic foramen, giving off the following-named branches:—

Lachrymal,—to the lachrymal gland, the upper eyelid, and the conjunctiva, anastomosing with the palpebral arteries.

Supra-orbital,—supplies the superior rectus and levator palpebræ muscles, the forehead and pericranial tissues.

Anterior and Posterior Ethmoidal,—to the dura mater, the nose, the anterior ethmoidal cells, and the frontal sinus.

Palpebral,—superior and inferior,—to the eyelids.

Frontal,—to the tissues of the forehead.

Nasal,—to the lachrymal sac, and the nose.

Short Ciliary, 12 or 15,—pierce the sclerotic at the lamina cribosa, supplying the choroid and the ciliary processes.

Long Ciliary, 2,—pierce the sclerotic, and pass forwards between it and the choroid, to supply the iris, forming two arterial circles thereon, the Circulus Major Iridis at the ciliary border, and the Circulus Arteriosus Iridis Minor near the pupillary margin.

Anterior Ciliary,—arise from the muscular branches, pierce the sclerotic, and join the great arterial circle of the iris.

Arteria Centralis Retinæ,—pierces the optic nerve obliquely, and is distributed to the retina.

Muscular Branches, 2,—superior and inferior, supply the muscles of the eyeball.

ANTERIOR CEREBRAL, branch of the Internal Carotid,—sends nutrient capillaries to the optic nerve.

NFRA-ORBITAL, branch of the Internal Maxillary artery,—sends branches to the inferior rectus and inferior oblique muscles, and to the lachrymal gland.

Name the Principal Lymph-spaces of the Eyeball. The—

anal of Schlemm,—around the circumference of the iris.

eri-choroidal Space,—between the choroid and the sclerotic.

Space of Tenon,—between the globe and its capsule.
Vaginal Spaces,—between the sheaths of the optic nerve.

What Veins has the Eye? It has two main trunks, the *Superior* and *Inferior Ophthalmic Veins*, which empty into the cavernous sinus, after collecting the blood from the smaller venous channels through the *Venæ Vorticosæ* of the choroid. The veins of the eye anastomose freely with the facial veins, thus permitting the escape of venous blood in either direction.

Describe the Nerves of the Eye. They are the—

Nerve of Special Sense,—the Optic, or 2d cranial nerve.

Motor Nerves,—the 3d, 4th, 6th, filaments of the 5th, and some fibres from the sympathetic.

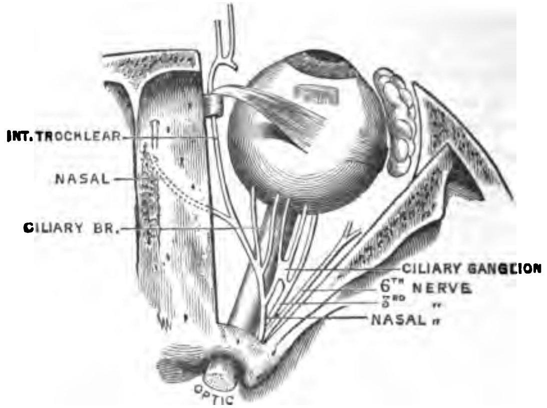
Sensory Nerve,—the Ophthalmic Division of the 5th, giving off the—

Lachrymal,—to the lachrymal gland, the conjunctiva, and the integument of the upper eyelid.

Frontal, { Supra-trochlear.
Supra-orbital.

Nasal. { Ganglionic.
Long Ciliary.
Infra-trochlear.

FIG. 103.



Sympathetic Branches,—arise from the medulla, cilio-spinal region, cavernous and carotid plexuses, and join the 3d, 4th, 5th, and 6th nerves, sending filaments to the dilator fibres of the iris, to the muscles of the orbit and lids, to the ciliary ganglion, and to the walls of the arteries.

Short Ciliary,—some 20 in number, arise from the *Ciliary Ganglion* [See *ante*, page 137], pierce the sclerotic and go to the ciliary muscle, choroid, iris, cornea, and to the sheath of the optic nerve.

Ascending,—from Meckel's ganglion [See *ante*, page 137], enter the orbit by the spheno-maxillary fissure, going to the optic nerve, the 6th nerve, and the ciliary ganglion.

Describe the formation and course of the Optic Tract. The fibres which form the optic tract have their deep origin in the optic thalamus, corpora geniculata, and the anterior corpora quadrigemina. The tract winds around the crus cerebri as a flattened band, receiving from the crus a few fibres of attachment, and also fibres from the lamina cinerea and the tuber cinereum. In front of the latter body the two tracts join to form the *Optic Commissure* or *Chiasm*. [See ^{2} on Fig. 61, page 130.]

What is the arrangement of the Fibres in the Optic Commissure? As generally described, the fibres undergo a partial decussation, as follows, viz., the—

Decussating Fibres,—are the most numerous. They lie in the centre of the commissure, and pass across to the opposite side, connecting the retina of each eye with the opposite cerebral hemisphere.

Longitudinal Fibres,—are the external fibres in the optic tracts, passing into the optic nerve of the same side, connecting each retina with the cerebral hemisphere of its own side.

Inter-cerebral Fibres,—situated posteriorly in the commissure, passing from one optic tract to the other.

Inter-retinal Fibres,—lie anteriorly in the commissure, passing from one optic nerve to the other, and connecting the retina of one eye with that of the other.

Describe the Optic Nerve. The Optic Nerve proper is the 2d cranial ierve, arises from the optic commissure, passes into the orbit by the optic foranen in company with the ophthalmic artery, is pierced by the central artery f the retina, and enters the eyeball posteriorly $\frac{1}{10}$ inch inwardly from its axis, iercing the sclerotic and choroid coats, and finally expanding in the retina. t is surrounded by a tubular process of dura mater, which as the nerve enters he orbit, subdivides to form both the sheath of the nerve and the periosteum f the orbit.

APPENDAGES OF THE EYE.

What are the Tutamina Oculi? They are the appendages of the eye, ncluding the—

Eyebrows, or Supercilia.
Eyelids, or Palpebræ.
Conjunctiva, or lining membrane.
Lachrymal Gland, and Ducts.
Lachrymal Sac.
Nasal Duct.

What are the Eyebrows? They are arched elevations of the integument over the supra-orbital arches, are covered with a row of short hairs, and are drawn downwards and inwards by the *Corrugator Supercilii* muscle. [*See* page 68.]

Describe the Eyelids. The Palpebræ, or Eyelids, are two thin, movable folds, placed in front of the eye, for its protection. The upper lid is the most movable one, having its own levator muscle, the Levator palpebræ superioris. [*See* page 68.] The—

Palpebral Fissure,—is the space between their free margins, its outer and inner angles being termed respectively the *External Canthus* and *Internal Canthus.*

Lacus Lachrymalis,—is a small triangular space at the internal canthus, between the lids and the globe.

Lachrymal Papilla,—on the edge of each lid, about ¼ inch from the internal canthus.

Punctum Lachrymale,—a minute orifice on each papilla, and the beginning of the lachrymal canal.

Describe the Structure of the Eyelids. They are composed externally of skin, internally of mucous membrane (the palpebral conjunctiva), and between these lie areolar tissue, the orbicularis muscle, tarsal cartilage, fibrous membrane, Meibomian glands, vessels and nerves. The—

Orbicularis Palpebrarum Muscle,—is very thin and pale. [*See* p. 68.]

Tensor Tarsi, or *Horner's Muscle*, [*See* p. 68]—is a portion of the orbicularis, compressing the punctum and the sac.

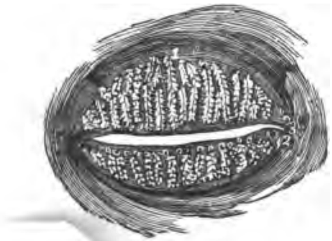
Tarsal Cartilages,—are plates of fibro-cartilage, forming the framework of the lids. The upper one is crescentic in shape, the lower one elliptical and smaller.

Tarsal Ligaments,—are fasciæ connecting the tarsal cartilages to the circumference of the orbit. Externally they connect with the malar bone, and are there called the *External Canthal Ligaments.*

Tendo Oculi,—connects the inner end of each tarsal cartilage to the nasal process of the superior maxillary bone.

Meibomian Glands,[1]—are sebaceous glands imbedded *in the tarsal cartilages*, 30 to 40 in the upper lid, 20 to 30 in the lower one. They open along the inner edge of the free border of each lid, and furnish a sebaceous secretion, to prevent adhesion of the lids to each other.

FIG. 104.



Eyelashes, or *Cilia,*—are a double or triple row of short hairs, situated on the free margins of the lids; their follicles lying in the connective tissue beneath the tarsal cartilages.

Arteries,—are the *Palpebral* branches of the ophthalmic artery, forming the *Superior and Inferior Tarsal Arches,* and anastomosing with the angular, anterior temporal, lachrymal and transverse facial.

Nerves,—the 3d, facial and sympathetic to the muscles; the 5th to the skin and conjunctiva.

What is the Conjunctiva? It is the mucous membrane which lines the eyelids, and is reflected over the front of the sclerotic and cornea. It is continuous with the mucous lining of the Meibomian glands, canaliculi, lachrymal sac, nasal duct, lachrymal duct and gland. The—

Palpebral Conjunctiva,—consists of connective tissue covered by epithelium, is traversed by furrows, and has papillæ and follicular glands.

Ocular Conjunctiva,—is very thin and transparent, loosely attached on the sclerotic, firmly adherent over the cornea, where it has no vessels in its structure. It has very few papillæ, and no glands.

Retro-tarsal or Palpebral Folds,—superior and inferior,—are where the conjunctiva is reflected over the globe. They contain prominent papillæ, and conglomerate glands, called the accessory lachrymal glands.

Plica Semilunaris, or Semi-lunar Folds,—a crescentic fold of conjunctiva at the inner canthus, considered to be the rudiment of the *Membrana Nictitans* or 3d eyelid (of birds).

What is the Caruncula Lachrymalis? It is a small, red, conical body, situated in the lacus lachrymalis, at the inner canthus of the eye; consisting of hair follicles and sebaceous glands, and covered by conjunctiva. It is connected by tendinous fibres to the capsule of Tenon and to the rectus internus muscle.

Name the parts constituting the Lachrymal Apparatus. They are the lachrymal gland and its ducts, the accessory conjunctival glands, the canaliculi, lachrymal sac, and nasal duct.

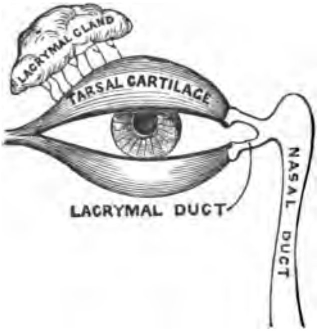
Describe the Lachrymal Gland. It is an oval gland situated in a fossa of the orbital portion of the frontal bone, at the outer angle of the orbit, its inferior surface resting on the eyeball, its lower margin or lobe being covered by conjunctiva. The—

Tarso-orbital Fascia,—connects the lachrymal gland to the bony roof of the orbit.

Ducts,—6 to 12 in number; open on the upper and outer portion of the palpebral conjunctiva.

Secretion—(tears),—lubricates the anterior surface of the eyeball. Excess evaporates, or collects in lacus and passes through puncta into canaliculi, and so to lachrymal sac, and thence, by the nasal duct, into the inferior meatus of the nose.

FIG. 105.



What are the Canaliculi? They are two minute canals, $\frac{1}{25}$ inch in diameter and $\frac{1}{3}$ inch long, which extend from the punctum in each lid to the lachrymal sac. They are lined with mucous membrane, and enveloped by fibres of the tensor tarsi muscle.

Describe the Lachrymal Sac. It is the superior dilated extremity of the nasal duct, and is situated in the groove formed by the lachrymal bone and the nasal process of the superior maxillary. Its form is oval, flattened antero-posteriorly; its dimensions about $\frac{2}{5}$ inch long and $\frac{1}{6}$ inch wide. Its fundus is crossed by the tarsal ligament, and by the tensor tarsi muscle. Its junction with the nasal duct may be interrupted by folds of the lining mucous membrane.

What is the Nasal Duct? A membranous canal extending from the lachrymal sac to the inferior meatus of the nose. It is about $\frac{3}{4}$ inch long, $\frac{1}{8}$ inch in diameter, is contained in the osseous lachrymal canal, curving downwards, backwards and outwards, and its calibre is narrowest about its middle. Its mucous lining is thick, and continuous with the Schneiderian membrane of the nasal cavity. Surrounding it is a vascular network of connective tissue, and outside this, a tendinous sheath. At its lower end a fold of mucous membrane forms an imperfect valve.

THE EAR.

What Bone contains the Auditory Apparatus? The petrous and mastoid portions of the Temporal bone. [Described on page 16.]

Name the Divisions of the Auditory Apparatus. The organ of hearing consists of the following parts, viz.—

1. *External Ear*........................	*Auricle, or Pinna.* *External Auditory Canal.*
2. *Middle Ear*, or *Tympanum*.........	*Membrana Tympani.* *Cavity of the Tympanum.* *Mastoid Cells.* *Eustachian Tube.*

3. *Internal Ear*, or *Labyrinth*	*Vestibule.* *Semicircular Canals.* *Cochlea.* *Auditory Nerve.*

THE EXTERNAL EAR.

Describe the Auricle. The Auricle or Pinna is the external irregularly shaped appendage, fastened to the malar and temporal bones by elastic fibres. It consists of a broad plate of yellow cartilage, deficient in places where its parts are joined together by ligamentous tissue, and is covered by perichondrium and integument, the latter containing sebaceous and sweat glands, and provided with short, downy hairs. The Auricle presents several elevations and depressions, named as follows:—

Concha,—the central cavity leading into the canal.

Tragus,—a conical eminence in front of the concha, usually covered with hairs along its inferior border.

Anti-tragus,—a similar projection facing the tragus, from which it is separated by a deep fissure, the *Incisura Intertragica.*

Helix,—the outer curved edge of the pinna, beneath which is a deep groove, the *Fossa Navicularis.*

Anti-helix,—a curved ridge along the posterior boundary of the concha, bifurcating above to enclose a triangular depression, named the *Fossa Triangularis.*

Lobe or Lobule,—the soft, pendulous portion, composed of integumentary, adipose and connective tissues.

Name the Muscles of the Auricle. The—

EXTRINSIC MUSCLES are the—

Attolens Aurem, Attrahens Aurem, Retrahens Aurem.

[These muscles are described on page 68.]

INTRINSIC MUSCLES are but slightly developed. They are the—

Tragicus,—lies vertically on the outer surface of the tragus.

Anti-tragicus,—on the posterior wall of the auditory canal.

Helicis Major,—vertically on the anterior border of the helix.

Helicis Minor,—on lateral surface of the root of the helix.

Transversus Auriculæ,—on the posterior surface of the auricle, radiating outwards from the convexity of the concha.

Obliquus Auriculæ,—also on the posterior surface, radiating upwards from the convexity of the concha.

Dilator of Concha,—on the tragus.

Name the Arteries and Nerves of the Auricle. The—

ARTERIES,—are derived from the External Carotid. The—

Posterior Auricular,—a main branch of the external carotid.

Anterior Auricular, branch of the Temporal br. of the ext. carotid.

Auricular,—branch of the Occipital branch of the ext. carotid.

NERVES,—are the—

Auriculus Magnus,—from the cervical plexus. [See p. 133.]

Posterior Auricular,—from the facial nerve.

Auricular,—branch of the pneumogastric (also called Arnold's nerve).

Auriculo-temporal,—branch of the inferior maxillary div. of the 5th.

Describe the External Auditory Canal. It is an osseo-cartilaginous tube, about 1¼ inch long, extending from the concha to the membrana tympani, and curved irregularly in its course. The cartilaginous, or external portion, is about ½ inch long, and deficient posteriorly and above, where it is filled by strong fibrous tissue. The canal is lined with integument, having numerous hair follicles, sebaceous and ceruminous glands.

Sulcus Tympanicus,—a groove at the bottom of the canal for the insertion of the membrana tympani. It is interrupted above by the—

Segment of Rivinus,—at the upper part of the sulcus tympanicus, each end having an osseous spine, the *Spina Tympanica Major* and *Minor*.

What are the Relations of the External Auditory Canal? *In fro* the articulation of the lower jaw; *below and in front*, the parotid glan *behind*, the mastoid cells and the transverse sinus; *above*, the mastoid ce and the dura mater of the brain.

Name its Vessels and Nerves. Its—

Arteries,—are branches of the Posterior and Deep Auricular.

Nerves,—are chiefly derived from the Temporo-auricular Branch of the infe maxillary division of the 5th nerve.

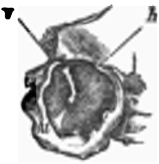
THE MEMBRANA TYMPANI.

What is the Membrana Tympani? The Membrana Tympani, o Drumhead, is an oval, inelastic, semi-transparent membrane, about $\frac{1}{250}$ in in thickness, situated obliquely at the bottom of the external auditory ca which it separates from the cavity of the tympanum. Seen through the ca it is of a delicate blue-gray color, arched inwards, and presenting for consi eration the following points, viz.:—A

Tubercle,—white in color at the upper border, made by the short proc of the malleus.

Stripe,—also white, running downwards from the tubercle, and formed the handle of the malleus.

FIG. 106.



Light-spot,—a triangular reflection, its apex at the tip of the malleus-handle, its base extending to the periphery of the membrane. It is due to the concavity of the drumhead.

Umbo,—or shadow, is the darker central portion.

Shrapnell's Membrane,—is the upper posterior part of the drumhead, where it is somewhat flaccid.

Rivinian Foramen,—a minute opening supposed to exist in the portion called Shrapnell's membrane.

In what direction is the Membrana Tympani placed? Obliquely inwards and forwards, almost forming a continuation of the posterior wall of the external auditory canal.

Describe the Structure of the Membrana Tympani. It is composed of 3 layers, as follows:—

External, or Dermoid Layer,—continuous with the integument lining the external auditory canal.

Middle Layer, or Lamina Propria,—formed of outer radiating fibres, and inner circular ones. Between these two sets of fibres are situated the short process and handle of the malleus.

Internal or Mucous Layer,—is continuous with the mucous lining of the tympanum.

Tendinous Ring (*At,* Fig. 106),—surrounds the margin of the membrane, being received into the sulcus tympanicus. Its anterior and posterior ends are shown by *v* and *h* in Fig. 106.

What Structures are presented by its Internal Surface? A fibrous fold descends from the upper portion of the marginal ring, for a short distance along the malleus-handle, forming the—

Anterior and Posterior Pouches,—one on each side of the malleus-handle, opening downwards.

Tendinous Bands,—4 or 5,—converge from the posterior margin to the middle of the malleus-handle.

What Arteries Supply the Membrana Tympani? The—

Deep Auricular, branch of the internal maxillary,—supplies the external layer, and forms with the Tympanic Branches a capillary plexus in the middle layer. (von Trölsch, Roosa, etc.)

Tympanic, branches of the internal maxillary and internal carotid arteries,—supply the internal layer, and anastomose on the membrana tympani with the—

Vidian and Stylo-mastoid,—branches respectively of the internal maxillary and posterior auricular branches of the external carotid.

What Nerves supply the Membrana Tympani? The external layer contains filaments from the *Superficial Temporal* branch of the 5th; the inner layer is supplied by the *Tympanic Plexus.* (See Nerves of Tympanum.)

THE TYMPANUM.

Describe the Tympanum. The Tympanum, Drum, or Middle Ear, is an irregularly-shaped cavity lying between the membrana tympani and the internal ear, and communicating with the pharyngeal cavity by the Eustachian tube. It contains the ossicles of the tympanum, part of the chorda tympani nerve, and air. Its average diameters are about $\frac{1}{2}$ inch antero-posteriorly, $\frac{1}{5}$ to $\frac{3}{5}$ inch vertically, and $\frac{1}{12}$ to $\frac{1}{6}$ inch transversely.

Name the Points on each wall of the Tympanum. Its—

ROOF,—is very thin, and corresponds to a depression on the anterior surface of the petrous portion of the temporal bone.

FLOOR,—is a thin plate, separating it from the jugular fossa and vein. Has—
- *Opening for Jacobson's Nerve,*—in the floor.

OUTER WALL,—is formed by the membrana tympani and presents the—
- *Iter Chordæ Posterius,*—opens close to posterior edge of drumhead, for the entrance of the chorda tympani nerve.
- *Iter Chordæ Anterius, or Canal of Hugier,*—opening just in front of the drumhead, for the exit of the chorda tympani nerve. (See p. 16.)
- *Glaserian Fissure,*—opens above and in front of the drumhead, receiving the long process of the malleus, the anterior ligament of the malleus, and the tympanic artery. (See *ante,* p. 15.)

INNER WALL,—is the outer wall of the labyrinth;—presents the—
- *Fenestra Ovalis,*—an oval opening, leading into the vestibule, and closed by a membrane, to which is attached the base of the stapes.
- *Fenestra Rotunda,*—a smaller opening, below the fenestra ovalis, leading into the scala tympani of the cochlea, and closed by the *Membrana Tympani Secundaria.*
- *Promonotory,*—an elevation corresponding to the first turn of the cochlea, situated between the fenestræ and in front of them.
- *Ridge of the Aqueductus Fallopii,*—above the fenestra ovalis, behind which it curves downwards along the posterior wall.
- *Pyramid,*—a conical eminence containing a canal which communicates with the aqueductus Fallopii and encloses the stapedius muscle.

ANTERIOR WALL,—presents the—
- *Opening of Canal for the Tensor Tympani Muscle,*—above, situated on a small projection, the *Anterior Pyramid.*
- *Opening of the Eustachian Tube,*—next below. These two canals being separated by a bony lamina, the *Septum Tubæ.*

Processus Cochleariformis,—the small end of the septum tubæ, projecting into the tympanum. (See p. 17.)

POSTERIOR WALL, separates it from the mastoid cells, and presents the—

Openings of the Mastoid Cells. *Ridge of the Aqueductus Fallopii*, curving downwards and nearly vertically. (See above.)

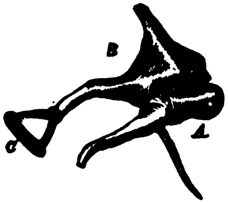
Describe the Ossicles of the Tympanum. They are three small bones, which form a chain across the tympanic cavity, connecting the membrana tympani with the fenestra ovalis, and named the—

Malleus, or Hammer, A—consists of a head, neck, short process, long process, or *Processus Gracilis*, and handle, or *Manubrium*. The short process and handle are fastened to the middle layer of the drumhead. The long process is received into the Glaserian fissure, and the head articulates with the head of the Incus.

Incus, or Anvil, B—has a head, also a long and a short process. The head articulates with the head of the malleus, the short process with the posterior wall of the tympanum, the long process with the head of the stapes, by the *Os Orbiculare*, its convex extremity.

Stapes, or Stirrup, C—presents a head, neck, base and crura. Its head articulates with the incus, its base rests on the membrane closing the fenestra ovalis, its neck receives the tendon of the stapedius muscle.

FIG. 107.



Name the Ligaments of the Ossicles. They are the—

igamentum Mallei Anterius,—from the spina tympanica major to the neck and long process of the malleus.

ig. Mallei Externum,—from the border of the Rivinian segment (p. 214), to the neck of the malleus. Its posterior fibres are the—

ig. Mallei Posticum,—(Laxator tympani minor muscle of Sömmering)—is simply the posterior group of fibres of the preceding ligament.

ig. Mallei Superius,—(Suspensory lig. of the malleus) from the roof of the tympanum to the head of the malleus.

ig. Incudis Superius,—from the roof of the tympanum to the head of the incus (Arnold).

ig. Incudis Posticum,—from the posterior wall of the tympanum to the short process of the incus.

ig. Obturatorium Stapedium,—a thin membrane which closes the opening between the crura of the stapes.

Annular Ligament,—connecting the base of the stapes to the margin of the fenestra ovalis.

Capsular Ligaments,—around the articulations between the ossicles themselves, which articulations are lined by synovial membranes, with articular cartilages between the contiguous surfaces.

Name the Muscles of the Tympanum. Three are usually described, —the *Tensor Tympani*, *Laxator Tympani*, and the *Stapedius*. A fourth, the *Laxator Tympani Minor*, is now generally omitted, being considered the posterior ligament of the malleus by most writers. Many otologists omit the Laxator Tympani from the list also. [These muscles are described on page 71.]

What Arteries supply the Tympanum? The—

Tympanic,—branch of the internal maxillary, entering the Glaserian fissure, anastomosing on the membrana tympani, in a vascular circle, with the Stylo-mastoid and Vidian arteries, and the Tympanic br. of the internal carotid.

Stylo-mastoid,—br. of the posterior auricular br. of the external carotid, entering at the stylo-mastoid foramen.

Petrosal,—br. of middle meningeal artery, entering by the hiatus Fallopii.

Tympanic,—br. from the internal carotid artery. (See p. 105.)

Vidian,—br. of the internal maxillary br. of the external carotid.

Branches,—from the ascending pharyngeal br. of the external carotid.

Name the Nerves of the Tympanum. The—

Tympanic Br. of the Glosso-pharyngeal (Jacobson's Nerve),—enters the tympanum through its floor, and supplies the two fenestræ and the mucous lining of the cavity, helping to form the *Tympanic Plexus* (see below).

Tympanic Branch of the Facial Nerve,—to the stapedius and laxator tympani muscles.

Branch from the Otic Ganglion,—to the tensor tympani muscle. [This ganglion is described on page 137.]

Chorda Tympani Br. of the Facial,—enters the tympanum by the iter chordæ posterius, crosses the cavity between the handle of the malleus and the long process of the incus, and makes its exit by the iter chordæ anterius, after passing close along the upper part of the membrana tympani.

How is the Tympanic Plexus Formed? By the—

Tympanic Br. of the Glosso-Pharyngeal,—or Jacobson's nerve.

Branch of the Superficial Petrosal, from the Facial,—entering from above.

Branches from the Carotid Plexus of the Sympathetic,—through the wall of the carotid canal.

The plexus lies in grooves on the inner wall around the promontory, and supplies the mucous membrane of the tympanum.

THE EUSTACHIAN TUBE.

What is the Eustachian Tube? It is an osseo-cartilaginous canal, about 1½ inches long, $\frac{1}{12}$ inch in diameter at tympanic end, ⅓ inch at pharyngeal, which leads downwards and forwards from the tympanic cavity into the pharynx. Of its length two-thirds is cartilaginous, one-third osseous. Above its bony portion is the canal for the tensor tympani muscle, from which it is divided by an osseous lamina, the *Septum Tubæ.* Its—

Cartilaginous Portion,—consists of two plates of cartilage, their non-approximated edges being connected by a membrane.

Pharyngeal Orifice,—is trumpet-shaped, and situated in the posterior nasal space, just above the nasal floor.

Mucous Membrane,—covered with the ciliated epithelium, and continuous with that of the pharynx and the tympanum.

Describe the Muscles of the Eustachian Tube. They are the—

Spheno-salpingo-staphylinus,—the abductor or dilator of the tube—is described as arising *from* the sphenoid bone and the cartilage of the tube, and being inserted *into* the convex border of the outer cartilage for its whole length. *Nerve,*—internal pterygoid.

Levator Veli Palati,—arises *from* the temporal bone and the cartilage of the tube,—*into* the osseous tube, the cartilage, and the mucous membrane. *Action,* to enlarge the transverse diameter of the tube. *Nerve,* pneumogastric.

Salpingo-pharyngeus,—a thin layer disposed along the median cartilaginous plate and the mucous membrane. *Action,* to fix the median cartilage. Called a fascia by some anatomists.

What Arteries supply the Eustachian Tube? The—

Ascending Pharyngeal,—branch of the external carotid.
Middle Meningeal,—branch of the internal maxillary br. of the ext. carotid.
Branch,—from the internal carotid artery.

Name its Nerves. Besides those which supply the muscles of the tube (see above), it has branches from the—

Superior Pharyngeal. *Glosso-pharyngeal.*

THE INTERNAL EAR.

Name the Parts comprised in the Internal Ear.

Osseous Labyrinth, consists of the
- *Vestibule.*
- *Semicircular Canals.*
- *Cochlea.*

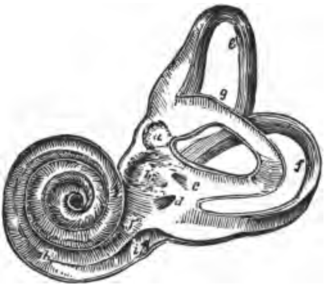
Membranous Labyrinth, comprises the
- *Utricle.*
- *Membranous Semicircular Canals.*
- *Saccule.*
- *Membranous Cochlea.*

Auditory Nerve,—the 8th cranial nerve, or the Portio Mollis of the 7th.
Organ of Corti,—the terminal auditory apparatus.
Internal Auditory Canal,—by which the auditory nerve enters.

Describe the general arrangement of the Internal Ear. It lies internal to the tympanum, within the petrous portion of the temporal bone, and consists of a series of osseous chambers, the *Osseous Labyrinth*, containing a fluid, the *Perilymph*, or *Liquor Cotunnii*, in which lies a membranous reproduction of the chambers, the *Membranous Labyrinth*, which also contains a fluid, the *Endolymph*, or *Liquor Scarpæ*. Upon the membranous labyrinth are distributed the terminal filaments of the auditory nerve, which being suspended between two fluids, are not only protected from injury, but enabled to perceive the most delicate vibrations which may be communicated to the fluids surrounding them.

Describe the Vestibule. It is the common cavity of communication between the osseous parts of the internal ear, and measures in vertical diameter about $\frac{1}{5}$ inch, laterally about $\frac{1}{10}$ inch. It communicates in front with the scala vestibuli of the cochlea; and behind (by five openings) with the semicircular canals. It presents the following points, viz.:—the—

FIG. 108.



Fenestra Ovalis,—on its outer wall, closed by the base of the stapes and its annular ligament.

Fovea Hemispherica, *b*—a small circular depression on the inner wall, for the saccule.

Maculæ Cricosæ,—are groups of very minute orifices on the inner wall, admitting the nerve filaments.

Crista, or Pyramidal Eminence,—a vertical ridge on the inner wall, bounding the fovea posteriorly.

Aqueductus Vestibuli, *d*—opens behind the crista, ending on the posterior surface of the petrous portion of the temporal bone. It contains a small blind canal opening by two arms, one into the utricle, the other into the saccule; also a small vein.

Fovea Semi-elliptica, *a*—a small oval depression on the roof, above and behind the fovea hemispherica. It lodges the utricle, and presents a *Macula Cribosa* for the entrance of branches of the vestibular nerve.

What are the Semicircular Canals? They are three C-shaped bony tubes, each about $\frac{1}{20}$ inch in diameter, situated above and behind the vestibule, into which they open by 5 apertures. Each canal lies at a right angle with the other two. The—

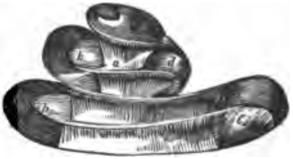
Superior and Posterior f Canals,—are each nearly an inch long, vertically placed, joined together posteriorly where they open into the vestibule by a common orifice.[c]

External Canal, g—is $\frac{1}{5}$ inch long, horizontally placed, and directed outwards and backwards.

Ampulla,—is a flask-shaped dilatation of each canal at one extremity, having a diameter of about $\frac{1}{10}$ inch.

Describe the Cochlea. The Cochlea is a bony tube, about 1½ inch long, apering from $\frac{1}{10}$ to $\frac{1}{20}$ inch in diameter, coiled around a central conical axis or 2½ turns, and resembling a snail-shell in appearance. It measures about ¼ inch in length and the same in breadth at the base. It is situated in front f the vestibule, its apex pointing forwards and outwards, and is separated rom the carotid canal in front by a thin all. Its—

FIG. 109.



Modiolus, a—is the central axis, conical in shape, channeled by small canals for the passage of arteries and nerves, and by a central one, the *Canalis Centralis Modioli.* Its apex is within the last coil of the cochlea, and is expanded into a funnel-shaped lamella, the *Infundibulum.*

Lamina Spiralis, b—is a thin, osseous plate, projecting from the modiolus half way across the spiral canal, and winding around the modiolus terminates near the apex in a hook-like or *Hamular Process.* Its deficiency in the last half turn of the cochlea forms the *Helicotrema,* a space in which the scalæ vestibuli and tympani unite. (See below.) It consists of two laminæ, [1], [2], between which pass the filaments of the cochlear nerve.[10] From its free edge the structures composing the membranous cochlea pass to their attachment on the opposite wall of the cavity. (See Fig. 111.)

Spiral Canal,—is the space between the modiolus and the outer wall of the cochlea. It makes 2½ turns,—from left to right in the right ear, from right to left in the left ear; and terminates in the *Cupola,* a cul-de-sac at the apex of the cochlea. It is divided, by the osseous lamina spiralis and the membranous cochlea, into 2 Scalæ,—the *Scala Vestibuli*[6] and the *Scala Tympani.*[7] [Fig. 111.]

[A third scala is described by many authorities, the *Scala Media*,[8] including the space occupied by the membranous cochlea. *See* Fig. 111.]

Describe the Scala Vestibuli. It is the portion of the spiral canal lying above the lamina spiralis and the membranous cochlea; communicates with the vestibule below, and with the scala tympani above at the Helicotrema. It is filled with perilymph.

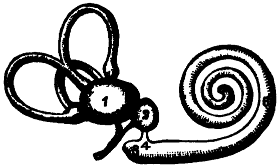
What is the Scala Tympani? It is the portion of the spiral canal lying below the lamina spiralis and the membranous cochlea, communicates with the aqueductus cochlea (see below), and with the scala vestibuli at the *Helicotrema.* It terminates inferiorly at the fenestra rotunda, and is filled with perilymph.

What is meant by the Helicotrema? It is a space at the apex of the cochlea, formed by the deficiency of the lamina spiralis in the last half turn of the same. In this space the two scalæ are believed to open, thereby communicating with each other.

What is the Aqueductus Cochleæ? A small canal which begins by a small orifice in the lower wall of the scala tympani, and runs in the inner wall of the jugular fossa, ending at the edge between the inferior and inner surfaces of the petrous portion of the temporal bone. It transmits a vein from the cochlea to the jugular vein.

What Parts are comprised in the Membranous Labyrinth? It consists of two membranous sacs, the *Utricle*[1] and *Saccule*,[2] which lie in the vestibule, together with the *Membranous Semicircular Canals*,[6] and the *Membranous Cochlea.*[8], [5] The utricle and saccule communicate with each other indirectly by a small canal contained in the aqueductus vestibuli. The saccule communicates with the membranous cochlea by the *Canalis Reuniens*,[4] and the membranous semicircular canals open into the utricle; so that the membranous labyrinth presents an uninterrupted channel for the endolymph which it contains.

FIG. 110.



What is the Utricle? It is a flattened, elliptical membranous sac, fastened to the inner wall of the vestibule in the fovea semi-elliptica. It is filled with endolymph, nearly surrounded by perilymph, and communicates with the saccule through the small tube in the aqueductus vestibuli. The membranous semicircular canals open into it by 5 orifices. The wall of the utricle has attached to it the—

Otoliths, or Ear-stones,—a powder, consisting of crystals of carbonate of calcium, $\frac{1}{8000}$ to $\frac{1}{2000}$ inch in diameter, held together by a mucoid substance.

Macula Acoustica,—See below, under *Saccule.*

Describe the Membranous Semicircular Canals. They are 3 canals, having the same shape as the osseous ones in which they are contained, being fastened thereto by their convex curves, and elsewhere surrounded by perilymph, except at the ampullæ, where they fill the osseous canals. They open into the utricle by 5 orifices.

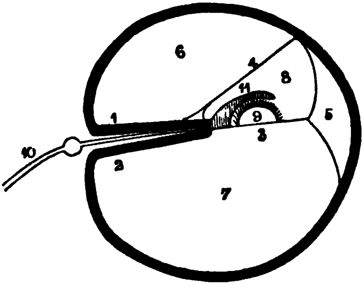
What is the Saccule? It is a flask-shaped, membranous sac, about $\frac{1}{18}$ inch in diameter, attached at one point to the utricle, and also to the fovea hemispherica of the vestibule, being elsewhere surrounded by perilymph, and containing endolymph. It communicates with the utricle through the small canal in the aqueductus vestibuli, and also with the membranous cochlea by its neck, the—

Canalis Reuniens,—about $\frac{1}{35}$ inch long and $\frac{1}{120}$ inch in diameter, is V-shaped, its arms opening respectively into the saccule and the vestibular end of the membranous cochlea.

Macula Acoustica,—is a dense, circular point, $\frac{1}{12}$ inch in diameter, on the wall of both the utricle and the saccule, formed by a thickening of the connective tissue where the fibres of the vestibular nerve enter it.

Describe the Membranous Cochlea. This portion of the membranous labyrinth, also called the *Ductus Cochlearis,* commences in the lower end of the osseous cochlea and send at its summit in a closed extremity. It is attached on one side to the lamina spiralis, on the other side to the outer wall of the osseous cochlea. It is formed by the *Membrana Basilaris*[3] below, the *Membrane of Reissner*[4] on one side, and the periosteum of the cochlear wall on the outer side, its cross-section being of a triangular form. It is filled with endolymph, and contains the *Organ of Corti*[9] covered by the *Membrana Tectoria.*[11] The—

FIG. 111.



Limbus Laminæ Spiralis,—is the soft structure on the edge of the lamina spiralis, and lies in the membranous cochlea. It has two lips,—an upper, or *Labium Vestibulare*, a lower, or *Labium Tympanicum*, with a furrow between them, called the *Sulcus Spiralis Internus*.

Membrane of Reissner,[4]—extends from the edge of the lamina spiralis to the outer cochlear wall, forming the vestibular wall of the membranous cochlea. Its outer insertion is the *Angulus Vestibularis*.

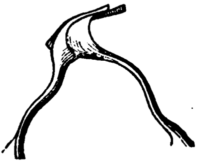
Membrana Basilaris,[8]—is the tympanic wall of the membranous cochlea, extending from the labium tympanicum of the lamina spiralis to the outer cochlear wall, where its insertion is called the *Ligamentum Spirale*,[5] or *Muscle of Todd and Bowman*. On it rests the *Organ of Corti*,[9]—covered by the —

Membrana Tectoria,[11]—extends parallel to the membrana basilaris from the labium vestibulare to the outer cochlear wall, where, according to some authorities, it is inserted, according to others it is free and rests directly on the organ of Corti, perhaps to act as a damper to its vibrations.

Describe the Organ of Corti. It is a peculiar arrangement of cartilaginous rods and epithelial hair cells, which is supposed to constitute the essential organ of hearing.[9] It lies on the membrana basilaris [8] and is covered by the membrana tectoria.[11] The—

Rods of Corti,—are arranged in two rows, resting, by their pedestals, on the membrana basilaris, and uniting with each other by their heads, so as to form an arched tunnel all along the membrane. Number of rods in inner row about 6,000, in outer row 4,500. Average diameter of the rods, from $\frac{1}{25000}$ to $\frac{1}{35000}$ inch.

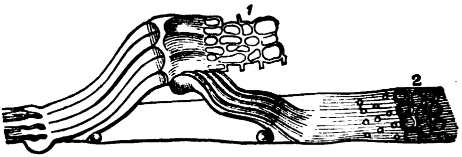
FIG. 112.



Head-plates,—are attached to the heads of the inner rods, for the reception of the rods of the opposite row.

Lamina Reticularis,[1]—a perforated delicate membrane which extends from the articulations of the rods outwards to the external wall of the cochlea.

FIG. 113.



Auditory Cells,[2]—are epithelial structures covering the inner surfaces of the walls and the floor of the membranous cochlea. Those which cover the inner rods by a single row number about 3,300, are nucleated, covered with tufts of cilia, and called the *Inner Hair-cells*. On the outer rods are 3 or 4 rows of similar cells, numbering about 18,000 and named the *Outer Hair-cells*.

Rings and Phalanges,[1]—are very minute structures which connect the ciliæ of the hair-cells together, and form the Lamina Reticularis. (See page 224.)

Describe the Origin, Course and Distribution of the Auditory Nerve. The 8th Cranial Nerve, or Portio Mollis of the 7th pair, arises by two roots from the medulla oblongata, one from the floor of the 4th ventricle, the other from a nucleus in the processus e cerebello ad medullam. It winds around the restiform body, from which it receives fibres, and emerges at the lower border of the pons, in company with the facial nerve. The two nerves pass into the internal auditory canal, at the bottom of which the auditory nerve divides into two branches, the vestibular and cochlear nerves. The—

Vestibular Nerve,—has a ganglionic swelling on it in the internal auditory canal, and then divides into 3 branches, which pass through the maculæ cribosæ, and are distributed to the utricle, saccule, and the ampullæ of the semicircular canals, respectively.

Cochlear Nerve,—gives off a small branch to the wall between the utricle and saccule, and then divides into numerous filaments which pass through the small canals into the modiolus, to form a plexus between the two plates of the lamina spiralis, from which filaments pass through the lower edge of the lamina to terminate in the spindle-shaped cells of the organ of Corti. (See page 224.)

Intumescentia Ganglioniformis Scarpæ,—is the ganglionic swelling on the vestibular nerve in the internal auditory canal.

Ganglion Spirale,—is a ganglion found on each filament of the cochlear nerve, just as it enters between the plates of the lamina spiralis.

What Arteries supply the Labyrinth? The—

Internal Auditory Artery, br. of the basilar (from the vertebral),—accompanies the auditory nerve into the internal auditory canal, where it divides into vestibular and cochlear branches.

Stylo-mastoid Artery, br. of the posterior auricular (from the external carotid),—sends some small branches to the internal ear.

Describe the Internal Auditory Canal. It begins by a large orifice on the posterior surface of the petrous portion of the temporal bone, and runs outwards for ⅓ inch, to end in a blind fossa, the floor of which is marked by 4 depressions, which are perforated by fine foramina, for the passage of the filaments of the auditory nerve to the labyrinth. One of these depressions is the—

Tractus Spiralis Forminosus,—a spiral-shaped depression containing a number of the above foramina, situated opposi the base of the cochlea.

Maculæ Cribosæ,—are the other 3 depressions.

HERNIA.

What is a Hernia? A protrusion of any viscus from its natural cavity. The term, when unqualified as to the viscus, is understood to mean a protrusion of the intestines or mesentery, or both, from the abdominal cavity.

Name the Herniæ of most importance anatomically.

Oblique Inguinal Hernia,—in which the protrusion follows the spermatic cord through the inguinal canal; passing to the outer side of the epigastric artery, and through both the internal and external abdominal rings.

Direct Inguinal Hernia,—occurs at Hesselbach's triangle, escaping to the inner side of the epigastric artery, and through the external abdominal ring only.

Femoral Hernia,—in which the protrusion descends through the femoral or crural canal.

INGUINAL HERNIA.

Where is the Inguinal Canal? It is a passage in the abdominal wall, parallel to Poupart's ligament, and just above it. It commences at the internal abdominal ring [5] and ends at the external abdominal ring,[1] being about 1½ inch in length. It serves for the passage of the spermatic cord in the male, and the round ligament of the uterus in the female; and is directed downwards and inwards. The—

Internal Abdominal Ring,[5]—is an oval opening in the transversalis fascia, formed by the prolongation of this fascia around the cord, as the infundibuliform fascia. It lies ½ inch above Poupart's ligament and midway between the anterior superior spine of the ilium and the spine of the pubes. It is bounded above and externally by the arched fibres of the transversalis muscle; below and internally by the epigastric vessels.

External Abdominal Ring,[1]—is a triangular opening in the aponeurosis of the external oblique muscle, situated just above and external to the crest of the pubes. It is about 1 inch long, and ½ inch wide, and is bounded laterally by its own margins, called the *Internal*[4] *and External*[3] *Pillars* of the ring. From these margins is given off the *Intercolumnar Fascia,* around the cord and testis.

What are the Boundaries of the Inguinal Canal?

Anteriorly,—the Skin, Superficial fascia, External oblique muscle, and the Internal oblique for its outer one-third.

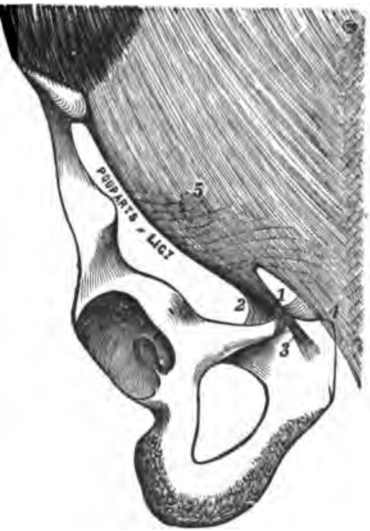
Posteriorly,—the Conjoined tendon, Transversalis fascia, Triangular ligament, Sub-peritoneal tissue, and Peritoneum.

Above,—the arched fibres of the Internal oblique and Transversalis muscles.

Below,—Poupart's ligament, and the Transversalis fascia.

What is Poupart's Ligament? The Crural Arch or Poupart's Ligaent is that portion of the aponeusis of the external oblique muscle hich extends from the anterior perior spine of the ilium to the ine of the pubes. Its lower poron[3] forms the external pillar of e external abdominal ring,[1] and s reflection along the pectineal line called *Gimbernat's Ligament.*[2] ther fibres, reflected behind the ternal pillar of the ring,[4] upward the linea alba, are termed the *riangular Ligament.*

FIG. 114.



What is the Relation of the pigastric Artery to the Internal bdominal Ring? The Epigasc artery lies between the transrsalis fascia and the peritoneum, ssing obliquely upwards and inrds along the lower and inner rgins of the internal ring.[5]

What is the Cremasteric Fascia? It consists of a series of muscular ps, united by areolar tissue, and forming a thin covering over the spermatic d. The muscular fibres (Cremaster muscle) are supposed to have been ginally part of the Internal oblique muscle, but carried down by the testicle its descent to the scrotum. It does not exist in the female.

Name the Coverings of Inguinal Hernia. In the oblique form of guinal Hernia the coverings are—

1. *Skin.*
2. *Superficial Fascia,*—2 layers.
3. *Intercolumnar Fascia,*—from the external abdominal ring.
4. *Cremasteric Fascia,*—from the inguinal canal.
5. *Infundibuliform Process* of the transversalis fascia,—from the internal abdominal ring.
6. *Peritoneum,*—the proper hernial sac.

the direct form of Inguinal Hernia, the coverings are precisely the same, xcept that the *Conjoined Tendon* is substituted for the Cremasteric fascia, nd the *Transversalis Fascia* for its Infundibuliform process.

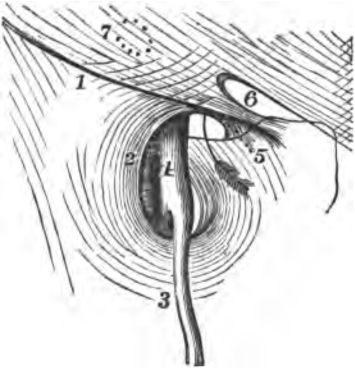
th covering is sometimes enumerated, viz.: the *Sub-serous Areolar Tissue,* which would come before the peritoneum in the above list. It is not sufficiently dense to make an appreciable covering.

FEMORAL HERNIA.

Where and What is the Femoral Canal? The Femoral or Crural Canal lies beneath Poupart's ligament,[1] close to the inner side of the femoral vein [4]; and extends from the *Femoral Ring* to the *Saphenous Opening* in the fascia lata of the thigh. It is a narrow interval between the femoral vein and the inner wall of the *Crural Sheath* or sheath of the vessels. The canal is ¼ to ½ inch in length; is closed above by the *Septum Crurale*, below by the *Cribriform Fascia;* and contains only some loose areolar tissue and a few lymphatic vessels. The—

Femoral or Crural Ring,—is an oval-shaped opening, about ½ inch in diameter (larger in the female), situated below the internal abdominal ring [7] and Poupart's ligament,[1] and between the inner side of the femoral vein and the margin of Gimbernat's ligament.[5] It is closed by the *Septum Crurale* and a small lymphatic gland. The arrow in the figure goes into the femoral ring.

FIG. 115.



Saphenous Opening,[2]—is an oval-shaped structure, 1½ inch long, ½ inch wide, situated below the inner third of Poupart's ligament, and formed by a reflection inwards of the fascia lata around the end of the internal saphenous vein.[3] The outer margin curves over to the spine of the pubes, and is named the *Falciform Process*, or *Ligament of Burns*, its pubic end being often called the *Ligament of Hey.* The inner margin curves upwards behind the saphenous vein and under the outer margin, and is blended with the pubic portion of the fascia lata over the pectineus muscle. The opening is covered by the *Cribriform Fascia.*

What are the Boundaries of the Femoral Canal?

Anteriorly,—Poupart's ligament, Transversalis fascia, and the Falciform Process of the fascia lata.

Posteriorly,—Iliac fascia, and Pubic portion of the fascia lata.

Externally,—the Septum covering the femoral vein.

Internally,—Transversalis fascia, Iliac fascia, Gimbernat's ligament, and the deep Crural arch.

Name the Structures in relation with the Femoral Ring. The—

Spermatic Cord,—in the male, lies directly above its anterior margin, replaced by the round ligament in the female.

Femoral Vein,[4]—lies next on its outer side.

Epigastric Artery,—crosses its upper and outer angle.

Obturator Artery,—when arising from a common trunk with the epigastric, as it does once in 3½ subjects, may lie close along its internal and superior margins.

What is the Septum Crurale? A layer of condensed cellular tissue, supporting a lymphatic gland, and perforated for the passage of lymphatic vessels. It lies across the femoral ring, and forms one of the coverings to any hernia escaping thereby. It is sometimes named the *Fascia of Cloquet*, or *Fascia of Cooper*.

Describe the Crural Sheath. It is the sheath which invests the femoral vessels below Poupart's ligament, and is formed by a prolongation of the transversalis fascia anteriorly, and the iliac fascia posteriorly. It is divided by two septa into 3 compartments, the exterior of which contains the *Femoral Artery*, the middle one the *Femoral Vein*, while the one most internal is the *Femoral Canal.* The sheath is perforated anteriorly by the genito-crural nerve, internally by the internal saphenous vein, and forms one of the coverings of a femoral hernia.

What is the Deep Crural Arch? It is the lower thickened border of the transversalis fascia, which arches across the front of the crural sheath, and is intimately connected therewith. It seems to be attached externally to the centre of Poupart's ligament; internally it is inserted into the pectineal line behind the conjoined tendon.

Name the Coverings of Femoral Hernia. From without inwards its coverings are the—

1. *Skin.*
2. *Superficial Fascia*,—2 layers.
3. *Cribriform Fascia*,—from the saphenous opening.
4. *Crural Sheath*,—from the transversalis fascia.
5. *Septum Crurale*,—from the femoral ring.
6. *Peritoneum*,—the proper hernial sac.

THE PERINEUM.

What is the Perineum? It is a triangular space containing the structures which close the pelvic outlet anterior to a line drawn between the tuberosities of the ischia. Posteriorly to this line the corresponding space is named the *Ischio-rectal Fossa.* The Perineum is bounded laterally by the rami of the pubes and ischia, anteriorly by the symphysis pubis, and posteriorly by the line above mentioned, which averages about 2¾ inches in length.

[For the Muscles of the Perineum, see *ante*, p. 83.]

THE MALE PERINEUM.

What Fasciæ are met with in the Perineum? The—

Superficial Layer of the Superficial Fascia,—is thick, loaded with fat, and continuous with the subcutaneous fascia of the thighs.

Deep Layer of the Superficial Fascia,—is thin but strong, continuous in front with the dartos of the scrotum, (?), attached on each side to the rami of the pubes and ischium; posteriorly it joins the deep perineal fascia under the transversus perinei muscle. It sends inwards a vertical septum which is incomplete in front. [This fascia is called by Professor Pancoast the "anterior leaflet of the triangular ligament."]

Anterior Layer of the Deep Perineal Fascia,—is triangular in shape, and extends from the pubic arch and the sub-pubic ligament, laterally to the rami of the pubes and ischia, and posteriorly to the central tendinous portion of the perineum, where it becomes blended with the deep layer of the superficial fascia. It embraces the anterior part of the membranous portion of the urethra. [Called by Professor Pancoast, the "middle leaflet of the triangular ligament."]

Posterior Layer of the Deep Perineal Fascia,—has the same attachments as the anterior layer above described, but in its course it embraces the posterior part of the membranous portion of the urethra, and is in connection with the apex of the prostate gland. [Called by Prof. Pancoast, the "posterior leaflet of the triangular ligament."]

Obturator Fascia,—is the part of the pelvic fascia which covers the obturator internus muscle, and is continued on to the levator ani muscle as the *Ischio-rectal* or *Anal fascia.*

Recto-vesical Fascia,—is the portion of the pelvic fascia which invests the internal surface of the levator ani muscle, and the prostate gland, bladder, rectum, and vesiculæ seminales.

What is Buck's Fascia? It is a continuation of the Deep Layer of the Superficial Fascia of the Perineum, extending forwards upon the penis, and investing that organ completely as far as the glans. It is continuous above with the suspensory ligament of the penis, and is held by some anatomists to prove that the deep layer aforesaid is not continuous in front with the dartos of the scrotum. This fascia was named from Dr. Buck, an American surgeon, who, in 1846, first insisted on the importance of this structure. It modifies the direction of urinary infiltration of the perineum, until perforated.

What is the Triangular Ligament of the Urethra? According to some authorities it is the anterior layer of the deep perineal fascia; according to others it includes the posterior layer also. Prof. Pancoast includes in the term "*Triangular Ligament*" all three layers which are united at the central tendinous portion of the perineum, including, therefore, the deep layer of the superficial perineal fascia.

Name the Structures which lie between the Layers of the Deep Perineal Fascia. In this space, which by some writers is termed the Cavity of the Triangular Ligament, are the—

Membranous Portion of the Urethra.
Compressor Urethræ Muscle.
Pudic Vessels and Nerve.
Cowper's Glands and Ducts.
Artery of the Bulb.
Nerve of the Bulb.
Plexus of Veins.

What Structures lie behind the Posterior Layer of the Deep Perineal Fascia? They are the—

Bladder.
Prostate Gland.
Rectum.
Levator Anti Muscle.
Ischio-rectal, or Anal Fascia.

Enumerate the Structures situated between the Anterior Layer of the Deep Perineal Fascia and the Deep Layer of the Superficial Perineal Fascia. They are as follows, the—

Crura of the Penis.
Corpus Spongiosum.
Bulb of the Urethra.
Accelerator Urinæ Muscle.[1]
Erector Penis Muscle.[2]
Transversus Perinei Muscle.[3]
Transversus Perinei Artery.
Superficial Perineal Vessels.

Enumerate the Structures which are divided in the Lateral Operation of Lithotomy. If the knife is inserted 1¼ inch above the verge of the anus, and carried to a point ¾ inch below that orifice, and about half-way outwards to the tuber ischii (*Gross*), it will divide the

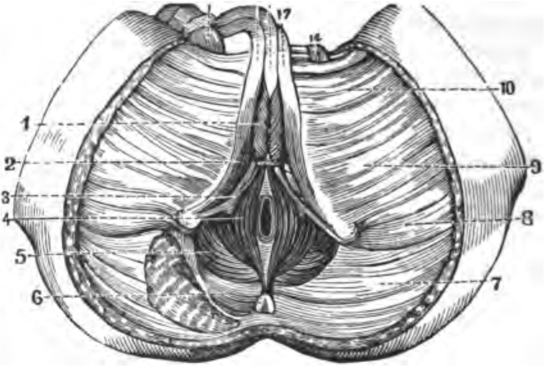
Skin and Superficial Fascia (1st Layer).
Inferior Hemorrhoidal Vessels and Nerves.
Deep Layer of the Superficial Fascia,
Superficial Perineal Vessels and Nerves.
Accelerator Urinæ Muscle[1] (posterior fibres).
Transversus Perinei Muscle[3] *and Artery.*

Anterior Layer of the Deep Perineal Fascia.
Compressor Urethræ Muscle (a few fibres).
Levator Ani Muscle [8] (anterior fibres).
Membranous and Prostatic Portions of the Urethra.
Posterior Layer of the Deep Perineal Fascia.
Prostate Gland (in part only).
Neck of the Bladder.

What Parts are to be avoided in the Lateral Operation of Lithotomy? They are the—

Bulb and its Artery,—in front.
Rectum,—inwardly and posteriorly.
Pudic Artery,—outwardly.

FIG. 116.



Prostate Gland and Veins,—by not carrying the deep incision too far backwards, the entire division of the left lobe of this gland will be avoided.

THE FEMALE PERINEUM.

What especial Function does the Female Perineum Perform? Tha of supporting the posterior wall of the vagina, and thereby aiding materially in the support of the whole vagina, uterus and bladder. The—

Perineal Body,—is the pyramidal-shaped prolongation of the female perineum upwards between the vagina and rectum.

Enumerate the chief points of Difference between the Female Perineum and that of the Male. The—

Orifice of the Vulva, including the vaginal orifice,—perforates the female perineum, its posterior commissure approaching the anal margin within about an inch.

Superficial Fascia,—is incomplete, by reason of its perforation by the orifice of the vulva, but consists of two layers, as in the male.

Deep Perineal Fascia,—being also perforated by the vagina, is less apparent than in the male, though presenting two layers, with the urethra perforating them, as in the other sex.

Muscles,—the Sphincter Vaginæ takes the place, in the female, of the Accelerator Urinæ of the male.

Prostate Gland is wanting,—but its place is occupied by a number of minute glands disposed around the neck of the bladder.

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Note.—Titles which contain the name of a person are entered twice, one entry being under the person's name, the other under that of the structure.

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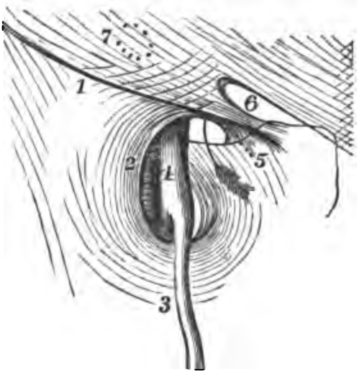
which would come before the peritoneum in the above list. It is not sufficiently dense to make an appreciable covering.

FEMORAL HERNIA.

Where and What is the Femoral Canal? The Femoral or Crural Canal lies beneath Poupart's ligament,[1] close to the inner side of the femoral vein [4]; and extends from the *Femoral Ring* to the *Saphenous Opening* in the fascia lata of the thigh. It is a narrow interval between the femoral vein and the inner wall of the *Crural Sheath* or sheath of the vessels. The canal is ¼ to ½ inch in length; is closed above by the *Septum Crurale*, below by the *Cribriform Fascia;* and contains only some loose areolar tissue and a few lymphatic vessels. The—

Femoral or Crural Ring,—is an oval-shaped opening, about ½ inch in diameter (larger in the female), situated below the internal abdominal ring [7] and Poupart's ligament,[1] and between the inner side of the femoral vein and the margin of Gimbernat's ligament.[5] It is closed by the *Septum Crurale* and a small lymphatic gland. The arrow in the figure goes into the femoral ring.

FIG. 115.



Saphenous Opening,[2]—is an oval-shaped structure, 1½ inch long, ½ inch wide, situated below the inner third of Poupart's ligament, and formed by a reflection inwards of the fascia lata around the end of the internal saphenous vein.[8] The outer margin curves over to the spine of the pubes, and is named the *Falciform Process*, or *Ligament of Burns*, its pubic end being often called the *Ligament of Hey*. The inner margin curves upwards behind the saphenous vein and under the outer margin, and is blended with the pubic portion of the fascia lata over the pectineus muscle. The opening is covered by the *Cribriform Fascia.*

What are the Boundaries of the Femoral Canal?

Anteriorly,—Poupart's ligament, Transversalis fascia, and the Falciform Process of the fascia lata.

Posteriorly,—Iliac fascia, and Pubic portion of the fascia lata.

Externally,—the Septum covering the femoral vein.

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?QUIZ-COMPENDS? No. 6.

A COMPEND

OF

MATERIA MEDICA, THERAPEUTICS, AND PRESCRIPTION WRITING;

WITH ESPECIAL REFERENCE TO THE PHYSIOLOGICAL ACTIONS OF DRUGS.

BASED ON THE LAST REVISION OF

The U. S. Pharmacopoeia,

INCLUDING ALSO MANY UNOFFICIAL REMEDIES.

BY

SAM'L O. L. POTTER, M.A., M.D.,

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FIFTH EDITION, ENTIRELY REWRITTEN AND ENLARGED.

PHILADELPHIA:
P. BLAKISTON, SON & CO.,
No. 1012 WALNUT STREET.
1888.

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PREFACE TO FIRST EDITION.

This Compend is based on the Sixth Revision of the U. S. Pharmacopœia, on the regular text books of Materia Medica and Therapeutics, particularly those by Bartholow, Wood, Ringer, Stillé, Phillips, Piffard, Biddle, Trousseau, and Waring; and on the author's own notes of two courses of didactic and clinical lectures by Professors Bartholow and Da Costa.

Intended as a book for medical students, brevity of statement is one of its principal features. At the same time, the essentials of the subject have been kept in view; from a desire to make the book not only the best of its kind, but a compact compendium of the established maxims of therapeutical science, and the most advanced views concerning the physiological actions of drugs. The preparations noted under each title are those in most general use; to have described all would have been to unnecessarily burden the student's memory.

FORT DOUGLAS, UTAH, FEBRUARY, 1883.

PREFACE TO FIFTH EDITION.

In this, the fifth edition, the former text has undergone another careful revision, and has been, in fact, almost entirely rewritten. Each section has received more or less elaboration; and nowhere has there been any contraction. The opening sections on Preparations and Classification of Medicines have been expanded from nine to twenty-five pages in the effort to do justice to these important subjects. In the portion of the book devoted to the

Materia Medica, new matter has been inserted, treating of 75 additional articles. Of these, 42 are described in new sections, namely—

Acetanilide.
Adonis.
Amylene.
Antipyrine.
Baptisia.
Benzoin.
Benzoic Acid.
Berberis.
Convallaria.
Caffeine.
Chinoline.
Chlorine.
Chlorides.
Cascara.
Drumine.
Erythrophlœum.
Fucus.
Frangula.
Hoang-nan.
Hypnone.
Ipecac.
Kairine.
Linum.
Mel.
Menthol.
Methylal.
Mints.
Naphthaline.
Paraldehyde.
Petrolatum.
Pitch.
Pyrogallol.
Saccharine.
Scilla.
Sparteine.
Strophanthus.
Tar.
Thalline.
Theine.
Thymol.
Turpentine.
Urethane.

Some of these were briefly noticed in the last edition. There are also new sections on Quinine Substitutes, Emollients and Demulcents, and Counterirritation. The remaining 33 are subjects of brief notices, namely:—

Aldehydes.
Bismuth Subiod.
Cannabin.
Hydronaphthol.
Hydroquinone.
Hedeoma.
Hyoscine.
Icthyol.
Indigo.
Iodol.
Ketones.
Larix.
Lanolin.
Myrtle.
Naphthol.
Origanum.
Oxalic Acid.
Paraffin.
Pinus Sylv.
Pinus Canad.
Pyrocatechin.
Pyridine.
Quebrachine.
Resina.
Salol.
Sanitas.
Succinum.
Tansy.
Terebene.
Terebinthene.
Thuja. Thus.
Viscum.

The authorities heretofore acknowledged have again been laid under contribution in their latest editions. I acknowledge my indebtedness particularly to Dr. Brunton's magnificent work, the third edition of which has furnished many valuable hints for this revision.

Once more I thank my brethren, the students and teachers of medicine, for the favor which they continue to extend to my compends. The rapid exhaustion of five large editions of each of these books is the best evidence that my efforts for the systematizing and facilitating of their studies are appreciated. The only return I can make is one I shall always aim at, namely—that each revision shall show a better book than the preceding one.

SAM'L O. LEWIS POTTER.

937 SUTTER STREET,
SAN FRANCISCO, JUNE, 1888.

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EXPLANATION.

*Preparations marked thus * are not official in the U. S. Pharmacopœia of 1880.*

The Doses given are for adults; for children the following rule (Young's) will be found the most convenient. Add 12 to the age, and divide by the age, to get the denominator of the fraction, the numerator of which is 1. Thus, for a child two years old, $\frac{2+12}{2} = 7$ and the dose is one-seventh of that for an adult. Of powerful narcotics scarcely more than one-half of this proportion should be used. Of mild cathartics, two or even three times the proportion given may be employed.

For Hypodermic Injection, the dose should be three-fourths of that used by the mouth; by rectum five-fourths of the same.

Pronunciation.—Attention is particularly directed to the accentuation of words commonly mispronounced; as, for example, acètas, átropa, chimáphila (*kima*), chlòridum, codèia, coníum, énema, iódidum, radìcis, rícinus, sinàpis, syrùpus, éczema, umbilìcus, abdòmen, brómidum.

The Sign (?) after a preparation signifies that it is of doubtful utility; after a statement of physiological action, that the question is disputed and as yet unsettled.

WEIGHTS AND MEASURES.

APOTHECARIES' OR TROY WEIGHT.

Pound.	Ounces.	Drachms.	Scruples.	Grains.
℔.	℥.	ʒ.	℈.	gr.
1	12	96	288	5760
	1	8	24	480
		1	3	60
			1	20

APOTHECARIES' OR WINE MEASURE.

Gallon.	Pints.	Fl'ounces.	Fl'dr'ms.	Minims.
C.	O.	f℥.	fʒ.	♏.
1	8	128	1024	61440
	1	16	128	7680
		1	8	480
			1	60

METRIC WEIGHTS.

1 Milligram	0.001	— gr. 1/65
1 Centigram	0.01	— gr. 1/6
1 Decigram	0.1	— gr. 1½
1 Gram	1.	— gr. 15.432
1 Kilogram	1000.	— gr. 2.7

APPROXIMATE EQUIVALENTS.

1 ♏ or 1 gr.	— .06 grams.
1 fʒ or 1 ʒ	— 4. "
1 f℥	— 30. "
1 ℥	— 31. "
1 f℥ Glycerin	— 37. "
1 f℥ Syrups	— 40. "

A COMPEND
OF
MATERIA MEDICA
AND
THERAPEUTICS.

INTRODUCTION.

Pharmacology, or the Doctrine of Drugs, (*φάρμακον, a drug, λόγος, a discourse*), is the science which treats of the drugs employed in medicine. It embraces, therefore, in its scope, all of Materia Medica and Therapeutics relating to drugs.

By a few writers this term is employed in a more restricted sense, so as to include only the physiological action of drugs,—a subdivision of Materia Medica, and a subject which is more correctly designated by the term *Pharmacodynamics*, (see below).

Pharmacy is the name of the *art* which supplements the *science* of Pharmacology, viz.:—the art of preparing drugs according to the requirements of the pharmacologist, and of dispensing them on the prescription of the therapeutist. It includes a thorough knowledge of the Materia Medica, an acquaintance with the theories and manipulations of chemistry, and an intimate practical experience in many special operations peculiar to itself.

MATERIA MEDICA AND THERAPEUTICS.

Materia Medica is that branch of Pharmacology which treats of the substances used as medicines, and describes their origin, composition, physical characteristics, chemical properties, modes of preparation and administration, and their physiological and toxicological actions. Its divisions are—

PHARMACODYNAMICS, (*φάρμακον, a drug, δύναμις, power*), signifying the discussion of the physiological action of drugs,—that is, the modifying power of drugs upon the normal physiological activity of the human organism.

TOXICOLOGY, (*τοξικὸν, a poison, λόγος, a discourse*), teaches of the effects of drugs when administered in poisonous doses; also of their drug-antagonists and chemical antidotes.

Therapeutics, (*θεραπεύειν, to attend upon*), relates to the treatment of disease, and includes the discussion of all matters relating to the science and art of healing. Not only does it consider the application of medicines to the alleviation or cure of disease, but it embraces the employment of all other agents which are capable of contributing to the accomplishment of that result.

The operations of Nature herself, the actions of the various substances described in the Materia Medica, also those of food, clothing, climate, heat, cold, electricity, and of all other remedial agents, forces and measures,—are all included in the term *Therapeutics*, which may be divided into two grand divisions, viz.—

NATURAL THERAPEUTICS, including the operations of the Vis Medicatrix Naturæ,—the modes and processes of healing which occur independently of Art, for the spontaneous decline and cure of disease. There is no fact in science more fully established than that the living organism is in itself adequate to the cure of all its curable disorders.

APPLIED THERAPEUTICS comprises the application by Art, of agents foreign to the living organism, for the purpose of aiding Nature to restore the body to a comparatively healthy condition.

When used in connection with Materia Medica, the term *Therapeutics* is restricted to the remedial uses of those substances only which are generally considered medicinal. When systematically discussed under the various titles of these substances, or under the names of the diseases treated therewith, the matter is termed the *Special Therapeutics* of a certain article or of a particular disease. When arranged so as to present certain great principles, which may be deduced from the mass of isolated therapeutical observations, it is termed *General Therapeutics*. Thus we say "the special therapeutics of Arsenic," —"the special therapeutics of Rheumatism,"—"the general therapeutics of digestion." Other divisions of the subject, constantly referred to in professional conversation and literature, are those designated by the terms *Empirical Therapeutics* and *Rational Therapeutics*.

By EMPIRICAL THERAPEUTICS we mean the employment of a drug, or other remedial agent or measure, in a certain case of disease, for the sole reason that some person had previously used it successfully in a case which was apparently identical with the one under treatment. Necessarily the original method in Therapeutics, its reign has continued to the present time, and it is by many authorities lauded as the Therapeutics of Experience, founded on observation and experiment. At best, however, it is utterly unscientific; and would be destructive to all exactness in therapeutical progress, if permitted to rule unchallenged. It is a mere elaboration of Mrs. A's advice to her daughter, Mrs. B, to give her baby hot saffron tea for the measles, because Mrs. C's great grandmother had brought a family of ten safely through the disease with no other medicinal aid.

RATIONAL THERAPEUTICS is the very antithesis of Empiricism, as it consists in the employment of remedies with a definite object, and for reasons based on known laws of the remedies and of the diseases. When working by this method we administer a certain drug in a certain disease, with a more or less clearly defined idea of the morbid conditions present, and of the modifying action of the drug upon those conditions. Based, as it is, upon pathology and pharmacodynamics, these upon physiology, and it upon chemistry and biology, its progress must be slow, being dependent upon the advances made in all these fundamental branches of knowledge.

PHARMACOPŒIAS AND DISPENSATORIES.

Drugs, (*Drugan,* to dry), are material agents of every kind employed in the treatment of disease. The term was formerly applied to vegetable medicaments in their original form, and is still, by many persons, used in a similar sense.

A Pharmacopœia is the official list of drugs and their preparations recognized by the medical profession in a certain country;—as THE PHARMACOPŒIA OF THE UNITED STATES, OF AMERICA, (U. S. P.),—The British Pharmacopœia, (B. P.), etc. In other countries this list has the force of law, being issued under governmental auspices; but in the United States it has only the prestige of a professional publication, being revised every ten years by a convention of delegates representing the medical and pharmaceutical professions. The sixth decennial revision of the U. S. Pharmacopœia was made in 1880, and published in 1882.

A Dispensatory is a Commentary upon one or more of the national pharmacopœias, treating in detail of the medicinal substances official therein, and their preparations, as well as of such unofficial ones as are of especial interest. It is a private publication, having such authority only as is conceded to the reputation of its author. The principal dispensatories are veritable drug-encyclopædias, so elaborately do they deal with every subject embraced therein. Those of acknowledged value are—

The Dispensatory of the United States of America, by Drs. Wood and Bache, of Philadelphia, 15th edition, edited by Wood, Remington and Stadtler. Philadelphia, J. B. Lippincott & Co. 1883.

The National Dispensatory, edited by Drs. Stillé and Maisch. 3rd edition. Philadelphia, Lea, Bros. & Co. 1883.

The American Dispensatory, by King and Lloyd, Cincinnati, is the recognized authority of the "eclectic" practitioners.

A Companion to the U. S. Pharmacopœia, by Drs. Oldberg and Wall. 2nd edition, New York, Wm. Wood & Co.—is an excellent book, but not so exhaustive as the others in its method of treating the subjects embraced in it.

A Companion to the British Pharmacopœia, by Peter Squire, is the standard student's text-book on drugs in England, but in no degree compares with the United States or National Dispensatories.

OFFICIAL PREPARATIONS.

The Preparations Official in the U. S. Pharmacopœia number thirty-three,—and are grouped as follows,—viz.—

LIQUID PREPARATIONS, (19).

Aqueous,—Waters, Solutions, Infusions, Decoctions, Syrups, Honeys, Mucilages, Mixtures; the last four containing sweet or viscid substances.

Alcoholic,—Fluid Extracts, Tinctures, Wines, Spirits, Elixir.

Ethereal,—Oleoresins, Collodions. *Oleaginous*,—Liniments, Oleates.
Acetous,—Vinegars. *Glycerines*,—Glycerites.

SOLID PREPARATIONS, (14).

Extracts.
Abstracts.
Resins.
Masses.
Pills.
Troches.
Confections.
Powders.
Triturations.
Papers.
Ointments.
Cerates.
Plasters.
Suppositories.

[Besides the above-mentioned there are the *Natural Preparations*, named the Alkaloids, the Glucosides, and other Neutral Principles, also the Acids, Alkalies, etc. The two latter groups are described under AGENTS ACTING ON THE DIGESTIVE SYSTEM.]

Abstracta, Abstracts,—are solid, dry, powdered preparations, each representing about twice the strength of the corresponding drug or its fluid extract. They are permanent and portable, not liable to variation in strength, nor to become hard and brittle. They were first introduced into the U. S. P. of 1880, and are 11 in number.

Aceta, Vinegars,—are solutions of the active principles of certain drugs in dilute acetic acid. They number only 4, are made by percolation, and each contain the soluble principles from 10 per cent. of drug.

Alkaloidea, Alkaloids, (termination, *—ina*, *—ine*)—are natural principles existing in plants, and extracted therefrom by chemical art. They are organic bases, forming salts with acids, and regarded as compound ammonias, products of albuminous decomposition in the plant-cells during the process of growth. Like ammonia, they all contain N, with C and H; most of them also containing O, though a few are devoid of the latter element, occurring as oily liquids,—*e.g.* Nicotine, Coniïne, Sparteine, Piperidine, Lupuline, Lobeline, Muscarine. Alkaloids are generally insoluble in water, but soluble in alcohol; and their salts are more soluble in water than in any other liquid. They are easily decomposed by alkalies or alkaline carbonates; and are precipitated from their solutions by a solution of Iodine in Iodide of Potassium, by Potassio-mercuric Iodide, and by Picric, Phospho-molybdic and Phospho-tungstic Acids. They generally have a powerful physiological action, and their official names always end in *—ina*, (*—ine*). Allied to the alkaloids are the organic products—

Leucomaïnes and Ptomaïnes,—the former being alkaloids produced by decomposition of albuminous matter in the living animal tissues during the normal processes of waste;—and the latter being alkaloids produced by putrefaction. Many of the ptomaïnes are identical with vegetable alkaloids.

There are 15 alkaloids official, either under their own names or under hose of one or more of their salts. Of the latter there are 8 Sulphates, 4 Hydrochlorates, and 1 each Bisulphate, Acetate, Hydrobromate, Salicylate and Valerianate. The official alkaloids are as follows, viz.—

Apomorphina.
Atropina.
Caffeina.
Cinchonidina.
Cinchonina.
Codeina.
Hyoscyamina.
Morphina.
Physostigmina.
Pilocarpina.
Piperina.
Quinidina.
Quinina.
Strychnina.
Veratrina.

Unofficial, but *Important Alkaloids* are the following, viz.—

Aconitine.
Antifebrine.
Antipyrine.
Berberine.
Chinoline.
Cocaine.
Colchicine.
Coniine.
Curarine.
Daturine.
Duboisine.
Emetine.
Gelsemine.
Homatropine.
Kaïrine.
Muscarine.
Pelletierine.
Thalline.

Aquæ, Waters,—are aqueous solutions of volatile substances, which may be either solids, liquids or gases. They are dissolved either—by solution in cold or hot water,—by filtration through an absorbent powder,—by percolation hrough cotton saturated with the substance,—or by distillation. They number 15 in all, including two forms of Aqua itself, viz.—Water and Distilled Water.

Cerata, Cerates,—are unctuous preparations, similar to ointments, but of a much firmer consistence, as they all contain wax, (cera), and do not melt below 104° F. There are 8 official cerates, including *Ceratum* itself, which is made by fusing together 30 parts of White Wax and 70 of Lard.

Charta, Papers,—are strips of paper medicated by impregnation with medicinal substances, or by coating therewith. The official papers number 3, one being intended for smoking, (Charta Potassii Nitratis), the others for application as vesicants or counterirritants.

Collodia, Collodions,—are liquid preparations, having for their base a solution of gun-cotton in a mixture of Ether and Alcohol. They number 4, and are intended for external use.

Confectiones, Confections,—are medicinal substances formed into a mass with sugar, honey, water, etc., with the object of rendering them palatable and preserving them from change. They number only 2, that of Rose and that of Senna.

Decocta, Decoctions,—are aqueous preparations of vegetable drugs, made by boiling them in water for 15 to 30 minutes, and adding enough water to make the finished product of ten per cent. strength, unless otherwise directed. Only 2 Decoctions are now official, out of 12 in the Phar. of 1870. They are not desirable preparations, as heating is injurious to the active principles of most plants.

Elixiria, Elixirs,—are aromatic, sweetened preparations, containing active medicinal agents in small quantity, and made with a menstruum of Alcohol 1 part and Water 3. There is only one official (Elixir Aurantii), which is practically a flavored, alcoholized syrup, intended as an excipient in prescribing extracts, salts and tinctures.

Emplastra, Plasters,—are solid compounds, of tenacious but pliable consistence, and intended for external application. They are prepared by incorporating the medicinal substances with certain bases, to make a mass, which is then spread evenly on chamois skin, muslin, or kid-skin. The official Plasters number 17.

Extracta, Extracts,—are solid or semi-solid preparations, obtained by evaporating solutions of vegetable principles. The drug is first powdered, and then percolated with an aqueous or alcoholic menstruum to exhaustion, when it is evaporated at a temperature not to exceed 122° F., to a pilular consistence, and in some cases has a small quantity of glycerin added to keep the mass from becoming hard. There are 32 official Extracts, of which one is an inspissated juice, (Extr. Taraxaci), and one is made by evaporating a Fluid Extract, (Extr. Ergotæ).

Extracta Fluida, Fluid Extracts,—are alcoholic solutions, or concentrated tinctures, of vegetable drugs, prepared by percolation and partial evaporation, with menstrua of Alcohol, diluted Alcohol, or Alcohol and Water in various proportions. They are of uniformly definite strength if the crude drugs are so, a cubic centimeter, or fluid gramme, representing in each case the medicinal powers of one gramme of the drug; or, approximately, one minim of the finished preparation representing the active constituents of one grain of the drug. There are 79 official fluid extracts, and several hundred unofficial ones, one manufacturing firm alone carrying over 400 on their trade-list. A class of superior fluid extracts, named *Normal Liquids*, has been introduced by Parke, Davis & Co., embracing all the official vegetable drugs in common use. It is claimed for these preparations that they are adjusted, by assays for alkaloids, at every stage of their manipulation, and that the preparation is finally adjusted to a standard alkaloidal strength, irrespective of the grade of the particular sample of the crude drug employed.

Glucosidea, Glucosides, (terminations, —*inum*, —*in*),—are organic compounds, belonging to the group of *Neutral Principles* which exist in plants;

and which are resolved into *glucose* and some other principle, by the action of reagents or natural ferments. Few, if any, of these compounds, contain any N,—but among them are some very active agents. The official glucosides number six, and like other neutral principles, are designated by titles which end, in Latin in —*inum*, (English, —*in*), viz.—

Chrysarobinum, (Chrysarobin).
Elaterinum, (Elaterin).
Glycyrrhizinum, (Glycyrrhizin).
Picrotoxinum, (Picrotoxin).
Salicinum, (Salicin).
Santoninum, (Santonin).

Besides these, there are several other substances recognized by pharmacopœial names which terminate in —*inum*, —*in*, but which have no relationship to the group of Glucosides. They are the following, viz.—

Benzinum, Benzin,—A distillate consisting of hydrocarbons.
Benzoinum, Benzoin,—A balsamic resin.
Chinoidinum, Chinoidin,—A mixture of Cinchona alkaloids.
Glycerinum, Glycerin,—A liquid obtained from fats or fixed oils.
Lupulinum, Lupulin,—A glandular powder from the hop.
Pepsinum, Pepsin,—A digestive principle.
Pyroxylinum, Pyroxylin,—Soluble gun-cotton.

Glycerita, Glycerites,—are mixtures of medicinal substances with glycerin, of which only 2 are now official,—the *Glyceritum Amyli* and *Vitelli*.

Infusi, Infusions,—are aqueous preparations of vegetable drugs, using hot or cold water, but without boiling, and in the proportion of ten per cent., unless otherwise directed. The official Infusions are 5 in number, varying from 1½ to 4 and 6 per cent. of drug to menstruum.

Linimenta, Liniments,—are thin, oleaginous preparations, for external use with friction, and are made by dissolving various drugs in oily liquids, or in alcoholic liquids containing fatty oils. There are 10 official Liniments, 4 of which have Cotton-seed Oil, 4 have Alcohol, and 2 have Oil of Turpentine, as their bases.

Liquores, Solutions,—include all aqueous solutions of non-volatile substances, except the syrups, infusions and decoctions, which naturally form distinctive classes. There are 28 official Solutions; of which 11 are simple aqueous solutions, 16 are chemical aqueous solutions, and 1 is a solution in Chloroform. (Liquor Gutta-perchæ.)

Massæ, Masses, Pill-masses,—are prepared as described under Pilulæ below, those which are official numbering 3, viz.—Massa Copaibæ, Massa Ferri Carbonatis, and Massa Hydrargyri.

Mellita, Honeys,—differ from Syrups merely in their having honey as their base. The *Oxymel* and *Oxymel Scillæ* of the B. P. are similar preparations, with the addition of Acetic Acid. There are 3 official Honeys, including the two forms of Honey itself, viz.—Mel, Mel Despumatum, and Mel Rosæ.

Misturæ, Mixtures,—are aqueous preparations of *insoluble* substances, held in suspension by a suitable vehicle. In extemporaneous pharmacy, however, the term *Mixture* is applied to every fluid compound intended for internal use, except a few which have distinctive titles, as Emulsions, Draughts, Enemas, Elixirs and Drinks. There are 11 official Mixtures, of which one is misnamed, and should be entitled a Solution, as it does not contain an insoluble substance, (Mistura Ferri et Ammonii Acetatis). Of the others 4 are emulsions, 4 contain insoluble powders in suspension by the aid of gum, sugar, etc., one does not contain insoluble powders in suspension, and one is an effervescing mixture.

Mucilagines, Mucilages,—are thick, viscid liquids, prepared by dissolving gum in water, or by extracting with water the mucilaginous principles of certain plants. They are easily spoiled, and hence should be kept only in small quantities. There are 5 official Mucilages.

Neutral Principles of plants include the *Carbo-hydrates*, (starch, sugars, gum, etc.),—*Albuminous Bodies*, which may act as ferments,—*Bitter Principles*,—and *Glucosides*.

Oleata, Oleates,—are liquid solutions of metallic salts and alkaloids in Oleic Acid, intended for external use. They are not definite chemical compounds, though the term *Oleates* is also employed in the drug trade to distinguish certain solid preparations which are claimed to be chemical compounds of the same acid with various bases. There are only 2 official Oleates, the Oleate of Mercury and the Oleate of Veratrine, the former being of 10 per cent., and the latter of 2 per cent. strength.

Oleoresinæ, Oleoresins,—are liquid preparations, consisting principally of natural oils and resins extracted from vegetable drugs by percolation with stronger Ether. They are the most concentrated liquid preparations of drugs which can be produced, and there are 6 official members of the class.

Pilulæ, Pills,—are spherical masses composed of medicinal agents, and intended to be swallowed whole. The "*pill-mass*" or "*mass*" consists of the active ingredients and the *excipient*, the latter being the substance which gives to the mass its adhesive and plastic qualities. Besides the 3 official Masses enumerated above, there are 15 official Pills, in the composition of which some 9 different excipients are specified. One pill-mass has no excipient, (Massa Copaibæ), one of its ingredients having sufficient moisture in itself to give it the necessary viscidity.

Pulveres, Powders,—consist of dry substances in a state of minute subdivision, obtained by pulverization; the ingredients being rubbed together in a mortar until reduced to a fine powder and thoroughly mixed. There are 9 official Pulveres, one of which is really a Trituration, viz.—the Pulvis Ipecacuanhæ et Opii.

Resinæ, Resins,—are solid preparations obtained by precipitating the resinous principles of plants from their alcoholic solutions by the agency of water. There are 4 official Resins, namely Resina Copaibæ, Jalapæ, Podophylli, and Scammonii.

Spiritus, Spirits,—are alcoholic solutions of volatile substances, which may be solids, liquids or gases. The official Spirits number 22, and are prepared either by simple solution, by solution with maceration, by gaseous solution, by chemical reaction, or by distillation.

Suppositoria, Suppositories,—are solid bodies consisting of medicinal substances incorporated with Cacao-butter, (Oleum Theobromæ), and intended for introduction into the rectum, vagina or urethra. There are no official suppositories specified, but the pharmacopœia prescribes a general formula for their preparation.

Syrupi, Syrups,—are concentrated solutions of Sugar in water or in aqueous liquids, sometimes containing Acetic Acid, and occasionally Alcohol. They are termed *simple*, *medicated*, or *flavored*, according as they are simple solutions of sugar in water alone, or contain soluble medicinal substances, or flavoring ingredients. The official syrups number 34.

Tincturæ, Tinctures,—are alcoholic solutions of medicinal substances, all, except one, (Tincture of Iodine), being from non-volatile bodies. They are prepared by percolation, maceration, solution or dilution; the menstrua employed being chiefly Alcohol and diluted Alcohol of various strengths, though in a few cases the Aromatic Spirit of Ammonia is used. There are 72 official Tinctures, varying in strength from 0.4 per cent. (Paregoric), to 65 per cent. (Soap). 2 have 5 per cent., 20 have 10, 9 have 15, 23 have 20, 1 has 26, 1 has 35, 1 (Aconite) has 40, and 3 have 50 per cent. of the active ingredient.

Tincturæ Herbarum Recentium, Tinctures of Fresh Herbs,—is the title of a general formula for the preparation of the so-called "Green Tinctures," according to which, unless otherwise directed, 50 parts of the fresh herb, bruised or crushed, are to be macerated in 100 of Alcohol for 14 days, then expressed and filtered.

Triturationes, Triturations,—are finely comminuted powders, each consisting of a suitable medicinal substance and Sugar of Milk as a diluent, in the proportion of 10 per cent. There is but one official Trituration, (Trituratio

2

Elaterini), though the Pulvis Ipecac et Opii practically belongs to this class, except in respect of the proportions prescribed.

Trochisci, Troches,—also called Pastilles, Tablets, or Lozenges,—are small flattened cakes consisting of medicinal substances incorporated with Sugar, Mucilage of Tragacanth, etc. There are 16 official Troches.

Unguenta, Ointments,—are soft, fatty mixtures of medicinal agents with a basis of lard, petrolatum, or fixed oils; intended for application to the skin by inunction. There are 26 official Ointments, including Unguentum itself, which is a mixture of Lard 80 and Yellow Wax 20 parts.

Vina, Wines,—when medicated are practically Tinctures, White Wine, of a definite alcoholic strength, being the menstruum used. There are 14 official Wines, of which number 3 are unmedicated, namely—Vinum Album, Vinum Album Fortius, and Vinum Rubrum.

UNOFFICIAL PREPARATIONS.

Balnea, Baths,—are often medicated, and then they become medicinal preparations. In prescribing for them, the ingredients only are enumerated, with directions that they shall be added to the necessary quantity of water,—usually about 20 gallons.

Bolus, Bolus,—is a solid preparation, larger than a pill, but intended to be swallowed whole.

Bougia, Bougies, or Pencils,—are urethral and uterine suppositories, made long and slim for adaptation to those canals. They consist of various solid medicaments, astringents usually,—which are incorporated with a basis of Gelatin 3 and Glycerin 1, melted together. The compound is finally run into well-oiled tubes, in which it cools to the proper shape, and is then cut into the proper lengths.

Cachets, Wafers,—are thin disks made of flour and water, forming a very convenient vehicle for the administration of many powdered drugs, such as Quinine Sulphate, Rhubarb, etc. The wafer is first moistened, with a very small quantity of water,—next the powdered drug is dropped upon it,—the edge of the wafer is bent inwards so as to completely cover up the powder, and the whole then forms a bolus, which can be swallowed easily.

Capsulæ, Capsules,—are short tubes made of gelatin, and of such sizes that one slips over the other, so as to form a cover for it. They are a very convenient means of administering oils or other nauseous drugs, as when filled they are swallowed as easily as large-sized pills, and quickly dissolve in the gastric fluids, setting their contents free in the stomach. Another form is the *Soluble*

Elastic Capsule, each one containing a dose of such medicines as Castor Oil, Cod-liver Oil, etc., enclosed in a yielding wall of gelatin, which bears any ordinary pressure, and accommodates itself readily to the shape of the œsophagus.

Cataplasmata, Poultices,—are well-known devices for applying heat and moisture to an external part, and are sometimes medicated with anodyne, counter-irritant, or disinfectant agents. They are always prepared at the residence of the patient, the prescription calling for the ingredients only. The British Phar. recognizes six of these preparations, but they are not official in the U. S. Phar.

Collunarium,—is a nasal douche or wash, consisting of a mixture of various substances with water, to which a little glycerin is often added.

Collyrium,—is a similar preparation for use on the eye,—an eye-wash;—and generally contains a soluble, astringent salt, dissolved in rose-water or filtered (not distilled) water, in the proportion of gr.j–v to the ℥.

Discus, A Disk,—is a thin scale of Gelatin, medicated as required, for local application to the eye. The various mydriatics, also several mild astringents and anodynes, are put up in this form for use by ophthalmologists.

Dragée,—is the French name for a sugar-coated pill;—*e. g.* "Dragées Ferrugineuses."

Electuaria, Electuaries,—are preparations of a similar character to Confections, consisting of medicinal powders, etc., beaten up with sugar, honey or molasses, to the consistence of a thick paste, and administered with a spoon, like preserves. The term is becoming obsolete.

Emulsiones, Emulsions,—are mixtures which contain an oil or a resin minutely subdivided and in a state of "suspension" in the mixture; the suspension being accomplished by the aid of some viscid excipient, as gum, soap, alkali, or yolk-of-egg. *Natural Emulsions* are such as exist ready formed in nature, as milk, the yolk-of-egg, etc.; and also the emulsions formed by rubbing up gum-resins with water,—the members of that class of substances, (Ammoniacum, Asafetida, Myrrh, etc.) each containing, along with its resin, a sufficient amount of gum to make a perfect emulsion when triturated with water.

Excipients used for emulsification are Acacia, Tragacanth, (either these gums in powder or their Mucilages), Yolk-of-Egg, Liquor Potassæ, Tincture of Senega, Tincture of Quillaia, Milk, Syrups, Soap, etc. To give good results, the following proportions in parts by weight are recommended, viz.—

	Gum Acacia.		Water.
1 part of Fixed Oils or Copaiba requires............	½	and	¾
1 " " Balsam of Peru "	2	"	1½
1 " " Oil of Turpentine "	1	"	1

Enemata, Enemas, Clysters,—are liquid preparations for injection into the rectum, and may be laxative, demulcent, nutritive, stimulant or vermifuge in character. Their diluent is always water, which should be warm or tepid, and with which are incorporated such medicaments as may be desired. They may consist of water alone, as a wash for the purpose of cleansing the lower bowel.

Fotus, A Fomentation,—is a Lotion used hot,—and may consist of water alone, or medicated with a soluble salt, or perhaps alcohol, turpentine, etc.

Gargarysma, A Gargle,—is a mixture or solution for application to the pharyngeal mucous membrane, and usually contains some astringent or disinfecting salt, with a vegetable astringent perhaps, and frequently honey,—all in aqueous solution or mixture.

Glycecol,—is a jelly troche, the base of which is a mixture of gelatin or isinglass with glycerin, called Glycecolloid.

Granulum, A Granule,—is a very small pill, also called *Parvule*, and usually composed of alkaloidal or other powerful drugs.

Haustus, A Draught,—is a mixture consisting of a single dose, and usually about one or two fluid-ounces in volume. The old-time *Black Draught* is, perhaps, the best known preparation of this class,—but having recently been promoted from the ranks, it is now commissioned in official pharmacy under the title *Infusum Sennæ Compositum*,—the Compound Infusion of Senna.

Inhalationes, Inhalations,—also called *Vapores*, Vapors,—are medicines in the form of a vapor, a gas, or an atomized spray, intended for inhalation for their local action on the respiratory mucous membrane. The best apparatus for the production of these preparations is the steam-atomizer;—but many substances may be inhaled from the surface of hot water,—from a sponge in a wide-mouthed bottle surrounded by a hot cloth,—or from a heated slab of stone or iron.

Injectiones, Injections,—are aqueous preparations, intended for introduction into the cavities of the body by means of a syringe; and are termed *vaginal*, *urethral*, *vesical*, *nasal*, *aural*, *hypodermic*, etc., according to the locality wherein employed. A special form of syringe is employed in each case.

Lotio, A Lotion or Wash,—is an aqueous solution or mixture of medicinal agents, intended for external use, and usually consisting of some soluble, astringent salt, dissolved in water, together with, perhaps, some glycerin or alcohol. The best known Lotion is the "*Leadwater and Laudanum*" of daily use as an anodyne, refrigerant and astringent application.

Pessaria, Pessaries,—are suppositories of large size for use in the vagina. The term is also applied to certain mechanical contrivances used by gynecoloists to support the uterus in position, and hence its medicinal application is ll but obsolete.

Pigmenta, Paints,—are fluid or semi-fluid preparations for external use, to e applied with a brush over inflamed joints, in skin-diseases, or to the phayngeal mucous membrane. The familiar application of *Tincture of Iodine,* ainted over the skin as a counter-irritant and sorbefacient, is the best-known xample of this class.

Potus, A Drink,—is a mixture or solution, intended to be used *ad libitum,*—nd usually consists of a Potassium salt, or a mineral acid, in dilute solution, weetened and flavored to the patient's taste.

ADMINISTRATION OF MEDICINES.

Medicines may be introduced into the circulation by various routes, as the gastro-intestinal tract, the rectum, the respiratory tract, the veins and arteries, the subcutaneous cellular tissue, and the integument itself.

The Gastro-intestinal Route is the one most frequently employed, being the most convenient. The remedies, after being swallowed, find their way into the current of the circulation, through the walls of the gastro-intestinal bloodvessels and the lacteals. When the stomach is empty and its mucous membrane healthy, crystalloidal substances in solution pass through the walls of its vessels with great rapidity. Colloidal substances (fats, albumen, gum, gelatin, etc.) require to be digested and emulsified before they can be absorbed.

The Rectum will absorb many substances applied in the forms of Enemata or Suppositories. Those most suited to this route are the salts of the alkaloids in solution, especially those of Morphine, Atropine and Strychnine, the latter being absorbed more rapidly per rectum than by the stomach. Acid solutions, if not too frequently repeated, are also well administered by this channel.

The Respiratory Tract admits of the rapid absorption of medicinal substances through its extensive blood-supply. The inhalation of vapors or atomized fluids, the insufflation of powders into the nares, fauces, larynx, etc., and the use of a medicated nasal douche, are methods whereby this channel may be utilized.

The Veins are only used as a route of medication in emergencies, where the other channels are not available, and where immediate action is necessary to the preservation of life, the operation being a highly dangerous one. The injection intravenously of *Saline Solutions* in the collapse of cholera, diabetic coma, etc.—*Blood or Milk* as a last resort in excessive hemorrhage, epilepsy, uræmia, the collapse of cholera, etc.,—and a solution of *Ammonia* for the bites of venomous reptiles, Hydrocyanic-acid poisoning, Opium narcosis, Chloroform asphyxia, etc., are the instances admitted in practice.

Arterial Transfusion has also been performed successfully in a number of cases, and is considered safer than venous transfusion when a large quantity of fluid has to be introduced into the circulation. A special apparatus is employed for these purposes, known as Aveling's Transfusion Syringe, but the ordinary Dieulafoy's aspirator slightly modified, may be used with safety and convenience. The danger of the operation lies in the liability of air to introduction into the circulation, an occurrence which causes instant death in the human subject.

The Hypodermic Method is the introduction of medicines into the organism by injecting them into the subcutaneous areolar tissue, from which they are quickly absorbed by the lymphatic and capillary vessels.

The medicines must be in solution, of neutral reaction and freshly prepared, the usual menstruum being distilled water; though spring water filtered will answer just as well, and much better than distilled water which has been standing several days, and exposed from time to time to the air. The solution is to be injected *beneath* the skin, by a hypodermic syringe, care being taken to avoid puncturing a vein. The most suitable localities for the injection are the *external* aspect of the arms and thighs, the abdomen, the back, and the calves of the legs. On the external aspect of the thigh, just in front of the great trochanter, there is an area of some two inches square, over which the insertion of a fine hypodermic needle is not felt, so barren is the skin in that region of sensitive nerve filaments.

After nearly filling the syringe with the solution to be used, the needle should be screwed on tightly; and with the instrument held in a vertical position, point uppermost, the excess of solution over the amount required should be ejected, thus expelling air-bubbles and filling the needle itself. The needle should then be quickly inserted until its point has passed *beneath* the skin, when the piston may be pressed down slowly, delivering the solution gradually so as to avoid rupturing the tissue. If the solutions are freshly prepared with clean water, the needles kept clean and sharp, and the injection be made *beneath* the skin *not into it*, there will be no risk of producing abscesses with the agents ordinarily employed.

Parenchymatous Injection is the delivery of a medicine deeply into the tissues, either to affect a muscle itself or to locally influence some important nerve-trunk. The principal agents used in this manner are Strychnine for palsied muscles, Chloroform for sciatic and other neuralgias, and Salts of Cocaine for local anæsthesia.

The Skin is an active absorbent of crystalloidal substances when its epidermis or cuticle is removed. By this route there are four methods of introducing medicaments into the circulation, viz.—the Enepidermic, Epidermic and Endermic Methods, and Inoculation.

The Enepidermic Method consists in placing the medicine in simple contact with the epidermis, no friction being used to hasten its penetration. Solutions of the alkaloids in Chloroform and Oleic Acid pass by osmosis in this manner with comparative ease, but aqueous solutions act very slowly, and alcoholic ones with great difficulty if at all.

The Epidermic Method consists in the use of friction to promote the passage of the medicament between the cells of the epidermis. Mercurial Ointment, Cod-liver Oil, and other fats, Oleates, etc., are used in this way for their local and systemic effects.

The Endermic Method obviates the difficulty of absorption through the cuticle by removing the latter through the agency of a blister, and then powdering the medicament over the surface of the denuded derma.

An ordinary cantharides-plaster, followed by a poultice to raise the blister, may be employed ; but a quicker method is to place upon the skin a piece of lint soaked in Stronger Water of Ammonia, covering it with a watch-glass or a piece of oiled silk to prevent evaporation. The blister raises rapidly and should then be removed with scissors. Morphine, Atropine, Quinine and Strychnine, are the agents generally used in this manner, but the method is painful and unpopular.

Inoculation is the introduction of medicinal agents through the scraped or punctured skin by an operation similar to that employed for vaccination.

CLASSIFICATION OF MEDICINES.

Every medicine should be first studied as an individual, both with respect to its physiological actions and its therapeutical applications. When the student has thus familiarized himself with the characteristic features of each article of the Materia Medica, he may commence to seek out their more delicate lights and shades, by comparing them, one with another, according to their general scope of action and application. In order to do this intelligently, some method of classification becomes necessary, to guide and direct the mind, and to assist the memory, in grasping the subject with a firm grip.

STIMULANTS AND SEDATIVES.

Stimulant, (*stimulus,* a goad),—is a term which is used in various senses when applied to medicinal agents. It is properly employed when used to designate the action of any agent which increases the organic activity of any part of the organism. Alcoholic preparations are commonly termed " stimulants,'' though their action is that of a true narcotic. *Diffusible Stimulants* are those which have a prompt but transient effect, as Alcohol, Ammonia, Camphor, Ether, etc. *Spinal Stimulants* exalt the functions of the spinal cord, as Strychnine. *Cerebral Stimulants* those of the brain, as Opium. We also have Cardiac, Vaso-motor, Renal, Stomachic, Hepatic, Intestinal, and Cutaneous Stimulants, and many others, according to the special seat of the action in each case.

Sedatives, (*sedo,* to allay),—are agents which lessen the functional activity of organs, lower motility and diminish pain, and so exert a soothing influence on the system. So we have *General Sedatives*, which include the narcotics and anæsthetics,—the *Local Sedatives*, which affect a part only,—also Pulmonary, Spinal, Nervous, Vascular, Cardiac Sedatives, etc., all of which will be indicated under their appropriate titles.

All the groups which follow are merely local applications of the two foregoing grand divisions.

Agents Acting on the Nervous System.

Motor-Excitants—are agents which increase the functional activity of the spinal cord and the motor apparatus, producing heightened reflex excitability, disturbances of motility, and tetanic convulsions when given in large doses,—their ultimate result being motor paralysis from over-stimulation. Such are *Nux Vomica* and *Ignatia*, with their alkaloids, *Strychnine* and *Brucine*,—also *Thebaine* the tetanizing alkaloid of Opium, and Ergot, Picrotoxin, Digitalis, Pilocarpine, etc.

Motor-Depressants—lower the functional activity of the spinal cord and motor apparatus, and in large doses paralyze them directly. The principal members of this class are Alcohol, Ether, Chloroform, Opium, Aconite, Conium, Chloral, Tobacco, Lobelia, Belladonna, Gelsemium, Methyl-Strychnine, Methyl-Thebaine, etc.

Cerebral Excitants,—increase the functional activity of the cerebrum, without causing any subsequent depression or any suspension of brain-function. The chief members of this group are Camphor, Cannabis, Valerian, Caffeine, Theine, Cocaine, Tobacco, Strychnine, and Alcohol (in small doses).

Deliriants,—excite the functional activity of the higher brain to such a degree as to disorder the mental faculties, and produce intellectual confusion, loss of will-power, delirium and even convulsions. They are all narcotics, though narcotics are not all deliriants. Among these agents are Belladonna, Stramonium, Hyoscyamus, Cannabis Indica, Chloral, Lupulus (at first), Opium (at first), and Alcohol (in full doses).

Cerebral Depressants,—lower or suspend the functions of the higher brain after a preliminary stage of excitement. Under this head may be included the Narcotics, the General Anæsthetics, the Hypnotics, and many of the Antispasmodics,—all of which act upon the cells of the convolutions, and at first stimulating the cerebral functions, they produce after a time stupor, coma, and insensibility. The principal agents of this class are Alcohol (in large doses), Opium, Chloroform, Bromides, Chloral.

Narcotics, (*νάρκη*, stupor),—are drugs which lessen the relationship of the individual to the external world (Brunton. At first excitant to the higher brain, they soon cause profound sleep, characterized by increasing stupor,—and if the dose be sufficient, coma, insensibility, and finally death by paralysis of the centres in the medulla which govern respiration and the other functions of organic life. Narcotics are closely related to stimulants,—Alcohol and Opium being good illustrations, in the different stages of their actions, of stimulant followed by narcotic effects. Such agents give us the means of lowering hyper-acute perception, of inducing sleep, and of soothing the vital functions by rest,—all of which are means of great therapeutical value. The principal narcotics are Opium, Cannabis Indica, Alcohol, Belladonna, Humulus, Chloral, Chloroform, Ether, etc.

Hypnotics, (*ὕπνος*, sleep),—are agents which produce sleep, without causing any preliminary cerebral excitement, by bringing the brain into a favorable condition therefor. Such are the Bromides, Chloral, Paraldehyde, Cannabin Tannate, Methylal, etc., described under CHLORAL in the following pages.

Analgesics or **Anodynes**, (*ἀν*, without, *ἄλγος*, *ὀδυνη*, pain),—are agents which relieve pain, either by impairing the conductivity of the sensory nerve fibres, or by depressing the cerebral centres of perception and sensation. Opium does both, and hence it is the most efficient of all the analgesics. The *General Anodynes* act when taken internally, and affect the whole organism,—the *Local Anodynes* affect the part to which they are applied, some by direct depression of the terminal nerve-organs in the skin, others by reducing the local circulation. The principal agents of this class are as follows,—

General Anodynes.	*Local Anodynes*
Opium, (Morphine.)	Opium.
Belladonna, (Atropine.)	Belladonna.
Stramonium, (Daturine.)	Carbolic Acid.
Hyoscyamus, (Hyoscyamine.)	Cocaine.
Gelsemium, (Gelsemine.)	Veratrine.
Aconite, (Aconitine.)	Aconite.
Ether, Chloroform, etc.	Chloroform, etc.

Anæsthetics, (*ἀν*, without, *ἀισθήσις*, perception),—are agents which temporarily destroy sensation. The *General Anæsthetics* are volatile substances, which, when inhaled, produce more or less complete unconsciousness and loss of sensation, (anæsthesia), also lessened motor power. The *Local Anæsthetics* act similarly to the local anodynes, (see above), except that, while the latter diminish the sensibility of the part, the former destroy it entirely, for a time. The principal agents belonging to this group are the following-named,—

General Anæsthetics.

Ether, (Ethyl Oxide), $(C_2H_5)_2O$.
Methylic Ether, $(CH_3)_2O$.
Chloroform, (Bichlormethyl Chloride).
Methylene Bichloride, CH_2Cl_2.
Ethylene Bichloride, $C_2H_4Cl_2$.
Ethylidene Chloride, CH_3CHCl_2.
Nitrous Oxide, N_2O.

Local Anæsthetics.

Extreme Cold. Ice. Ether Spray or Methyl Chloride, CH_3Cl.
Carbolic Acid. Creasote.
Cocaine and its salts.
Oil of Turpentine.
Hydrocyanic Acid.
Veratrine.

Antispasmodics, (ἀντί, against, σπασμός, a spasm),—are agents which prevent or allay spasm of voluntary or involuntary muscles in any portion of the organism. In this group is included a long list of drugs, some of which act by tonic stimulation of the nerve-centres, and thereby of the coördinating power and the circulation (1),—others by direct depression of the motor centres, (2)—and others by paralyzing the end-organs of the vaso-motor nerves, (3). A few depress all the vital functions (4),—and a large number stimulate the muscular fibres of the intestines to expel gaseous accumulations (5). The following list includes the principal antispasmodics, the numbers referring to the special action of each, as stated above, viz.—

Alcohol, 1
Ether, 1
Camphor, 1
Musk, 1, 5
Valerian, 1, 5

Aconite, 4
Tobacco, 4
Lobelia, 4
Hellebore, 4
Hydrocy.Acid. 4

Bromides, 2
Amyl Nitrite, 2
Asafetida, 5
Cajuput, 5
Aromatic Oils, 5

Coördination of Movement, or the Maintenance of the Equilibrium, is the function apparently governed by the cerebellum, and is markedly disturbed by the few drugs which specifically affect that organ, chief among them being *Alcohol.* In considerable doses this drug causes a staggering gait, and a tendency to fall; and different preparations thereof seem to affect different portions of the cerebellum. Intoxication by wine or beer is said to be accompanied by a tendency to fall sideways,—that by whiskey, especially Irish whiskey, an inclination to fall on the face,—and that by cider a backward tendency; and these disturbances correspond exactly with those caused by injury to different lobes of the cerebellum (Brunton). *Apomorphine* in large doses seems to act upon the cerebellum or corpora quadrigemina, as the animal poisoned by it does not vomit, but moves round and round in a circle. (Idem).

AGENTS AFFECTING THE ORGANS OF SPECIAL SENSE.

Mydriatics,—are agents which cause dilatation of the pupil of the eye (mydriasis). Some act only when applied locally, others only when taken internally,—but the principal ones, *Atropine* and its congeners, act both locally and internally, and at the same time, produce temporary loss of accommodation, the eye remaining focussed for distant objects, and the intra-ocular tension being increased. The loss of accommodation is due to the drug's causing paralysis of the ciliary muscle,—and the dilatation of the pupil to its producing stimulation of the end-organs of the sympathetic nerve, and paralysis of the end-organs of the 3rd cranial (motor oculi) nerve; the former increasing the power of the radiating muscular fibres of the iris, and the latter lessening the power of its circular fibres. The smallest quantity of Atropine which will affect the pupil is stated by Donders as the $\frac{1}{7000000}$th of a grain. *Cocaine* acts by stimulation of the ends of the sympathetic alone, and does not paralyze the 3rd nerve. As a mydriatic it has peculiar qualities, which should make it preferred by eye-surgeons. These are referred to in detail in the body of the book under the title Erythroxylon. The chief mydriatics are—

Atropine.
Hyoscyamine.
Daturine.
Cocaine.
Duboisine.
Homatropin.
Anæsthetics, (at last).
Gelsemine, (locally only).
Belladonnine, (internally only).

Myotics, (μύω, to close),—are agents which produce contraction of the pupil (myosis). The principal local myotic, and the only one used in ophthalmic practice is *Eserine*, which acts by stimulating the circular muscular fibres of the iris,—at the same time contracting the ciliary muscle so that the eye is accommodated for near objects only, and diminishing intra-ocular tension,—in all of which respects it exactly antagonizes the action of Atropine, (see above). The other myotics are as follows, viz.—

Pilocarpine.
Muscarine.
Morphine.
Ergot.
Gelsemine (internally).
Lobeline (internally).
Nicotine (locally).
Anæsthetics (at first myotics, but mydriatics at last).

Ocular Sensibility is increased by *Strychnine*, the vision being thereby rendered more acute, and the field of vision being enlarged. This drug also increases the field of vision for blue colors, while *Eserine* diminishes it for red and green, and *Santonin* causes objects to appear of a violet color at first, and of a greenish-yellow color afterwards.

Amblyopia, or impairment of vision due to nerve changes, is often produced temporarily by Quinine, and may be permanently induced by Alcohol, Tobacco, Lead and Urea-poisoning.

Visions are caused by several drugs, the action of which is probably exerted on the sight-centres in the cerebrum (angular gyrus and occipital lobes),—rather than on the eye itself. The delirium and hallucinations produced by *Alcohol* are familiar examples,—the objects raised thereby being invariably animals, as snakes, toads, dogs, etc. *Cannabis Indica* often causes pleasant visions, while *Sodium Salicylate*, in some persons, produces very disagreeable ones. The *Bromides*, if taken in continued large doses, may, in the typhoid condition which follows, cause visions of such intense character that they are often impressed permanently on a brain which, at the time, was utterly unconscious of all its real surroundings. *Digitalis* may produce subjective sensations of the continued presence of light,—and *Cannabis Indica*, among the many curious effects produced by its ingestion in large doses, frequently gives origin to similar disturbances of the visual function, of indefinite and varied character.

The Ear is affected by several drugs. *Strychnine* and *Morphine* increase the excitability of either the auditory nerve, or the auditory centre in the superior temporo-sphenoidal convolution,—making that faculty much more acute than normal. *Quinine*, *Antipyrine*, and *Salicin* produce hyperæmia of the auditory apparatus, and cause subjective noises, such as humming, buzzing or ringing, which are very unpleasant to their subject.

The Smell is rendered more acute by *Strychnine*, and is depressed by all the cerebral depressants, and by such agents as cause changes in the nasal mucous membrane, as *Potassium Iodide*.

The Taste is not heightened or lowered as a faculty by any drugs that we know of. Each substance makes its own peculiar impression on the nerve-organs of taste, and that of one agent may be so potent as to overcome the impression left by another agent. The so-called "after-taste" of drugs is often entirely different to their original taste, and substances which are excreted by the salivary glands, (the Iodides, etc.) leave a very persistent after-taste behind them.

AGENTS ACTING ON RESPIRATION.

Respiratory Stimulants, exalt the function of the respiratory centres i the medulla, quickening and deepening the breathing. The most importa of these agents are—Strychnine, Atropine, Thebaine, Digitalis, Ammo Heat, Electricity, Tobacco (briefly), Alcohol (briefly), Ether (briefly), Opium (in small doses).

Respiratory Depressants, lower the action of the respiratory centre, re dering the respirations slow and shallow. The chief members of this gro are—Opium (in full doses), Gelsemium, Aconite, Veratrine, Conium, Chlo Alcohol, Ether, Chloroform, Caffeine, Cold, etc. Many of these at first exc the centre, but soon depress it.

Pulmonary Sedatives relieve cough and dyspnœa, by lessening the irritabi either of the respiratory centre or of the nerves of respiration. Some act direct depression of the respiratory centre, (as the *Depressants* above enumerated);—others by lessening local congestion, as the *Expectorants*, (see below);—and others by lowering the excitability of the vagus end-organs in the lungs and other afferent filaments throughout the respiratory tract. The most powerful of these directly sedative agents is *Opium*, and next are *Hydrocyanic Acid* and *Potassium Cyanide*. Others are—*Belladonna* and its congeners, which stimulate the centre but depress the vagus end-organs, and arrest secretion in the bronchi;—Cannabis Indica, Quebracho, Codeine, Amyl Nitrite, Turpentine, Iodide of Ethyl, Conium, Tobacco, etc.

Expectorants, (*ex*, out of, *pectus*, the breast),—are agents which modify the broncho-pulmonary mucous secretion, and promote its expulsion. They, consequently, act as pulmonary sedatives, indirectly; and are subdivided into—

Nauseating Expectorants, in small doses increase osmosis from the inflamed mucous membrane, in large doses cause vomiting and the mechanical expulsion of the mucus. They also increase secretion generally, and lower the blood-pressure. Such are Antimonial salts, (Tartar Emetic, etc.), Ipecacuanha, Lobelia, Jaborandi, Apomorphine, Alkalies, etc.

Stimulant Expectorants,—are eliminated from the system largely by the bronchial mucous membrane, which they at the same time stimulate, thus altering its secretion, and facilitating expectoration. They diminish secretion generally, and increase the blood-pressure, and include the Ammonium salts, Balsams of Peru and Tolu, Benzoin, Ammoniac, Squill, Senega, Nux Vomica, Terebinthinates, Sulphur, Saccharines and Acids.

Ciliary Excitants,—promote the expulsion of bronchial mucus by their reflex excitation of the tracheal and bronchial cilia when dissolved in the mouth. This group includes such agents as the Chlorides of Ammonium and Sodium, Potassium Chlorate, and Gum Acacia.

Errhines and Sternutatories,—are agents, which, when locally applied to the nasal mucous membrane, produce sneezing and increase of the nasal secretion. The first term, (ἐν, in, ῥίν, the nose), is usually applied to substances which simply increase the mucous discharge,—the second, (*sternuto*, to sneeze), to those which invariably produce the violent expiratory effort called sneezing. Both should be in powder-form for application. Another result of their use is the stimulation of the vaso-motor centre at the same time that they excite the respiratory centre,—thus producing a contraction of the smaller vessels throughout the body, and consequently a general rise in the blood-pressure. This class includes—Ammonia-vapor (dilute), Cubebs smoke, etc., which are simple errhines,—and the vapor of stronger Ammonia-water, Tobacco, Ipecacuanha, Sanguinaria, Ginger, Veratrum Album, etc., in powder, as snuff.

AGENTS ACTING ON THE CIRCULATION.

Cardiac Stimulants—are such agents as rapidly increase the force and frequency of the pulse, in depressed conditions of the cardiac apparatus. The most rapid, energetic and available agents of this class are *Ether*, *Alcohol*, *Heat* and *Ammonia*, the last-named also stimulating the vaso-motor centre. The list also includes—Sparteine, Atropine, Cocaine, Morphine (in small doses), Camphor, Chloroform, Turpentine, the Aromatic Oils, Counter-irritation, the continuous Galvanic Current, Nitro-glycerin, etc.

Cardiac Tonics,—in moderate doses stimulate the cardiac muscle, slowing and lengthening its contractions;—but in large doses they produce irregular action of the heart, and some of them may cause sudden death by syncope if pushed to any great extent. The typical agent of this class is *Digitalis*, which also contracts the arterioles and greatly increases the blood-pressure. Others less powerful and correspondingly safer, are—Convallaria, Strophanthus, Squill, Cimicifuga, and Erythrophlœum. The list also includes Caffeine, Strychnine, Helleboreïn and Adonidin (from Adonis vernalis).

Cardiac Sedatives,—lessen the force and frequency of the heart's action. They are used to control palpitation and overaction of that organ, also to slow the pulse in febrile conditions in sthenic subjects, especially when local inflammation is the exciting cause thereof. Most of them are direct cardiac poisons depressing both the heart-muscle and the motor ganglia. This list includes—*Aconite* and *Veratrum Viride*, also Muscarine, Pilocarpine, Saponin, Hydrocyanic Acid, Antimony, Potassium salts and Digitalis,—the last-named acting as a sedative by stimulation of the vagus centre and the cardiac muscle, slowing the rate and giving regular rhythm to the action of the heart.

Vascular Stimulants,—dilate the peripheral vessels, and increase the peripheral circulation; thus equalizing blood-pressure and preventing internal congestions. The most useful are *Alcohol* and *Ether*, as they stimulate the action of the heart simultaneously with the vascular relaxation. The other chief members of the group are—Nitrites, Nitro-glycerin, Nitrous Ether, Liquor Ammonii Acetatis, Opium with Ipecac, (as in Dover's powder), and Heat applied locally by poultices, etc.

Vascular Tonics and Sedatives,—are a group of agents which increase the contractile power of the arterioles, thereby lessening the capillary circulation, and raising the blood-pressure. They do this by a stimulating action upon either the vaso-motor centre or its mechanism in the walls of the vessels. Their most important uses are the checking of hemorrhages, and the cutting short of local inflammations. This group is well represented by *Ergot* and *Digitalis*, and besides these it includes—Squill, Opium in small doses, Stry nine, Salts of Iron, Lead and Silver, Hamamelis, and Cold, applied locally,—as by the Ether spray, or evaporating lotions containing Alcohol, Vinegar, Ammonium Chloride, etc.

Agents acting on the Digestive System.

Dentifrices, (*dens*, a tooth, *frico*, I rub),—are medicated pastes or powders employed with a stiff brush to cleanse the teeth and gums. Their base is usually *Chalk*, for its mechanical action and its alkaline quality; besides which, there should be some antiseptic, as *Quinine*, *Borax*, etc., and an aromatic stimulant, like *Myrrh*.

The Teeth are injuriously affected by several drugs, especially the *Mineral Acids*, and the *Persalts of Iron*. These should always be administered through a glass tube, and the mouth should be rinsed out afterwards with a weak alkaline solution.

Dental Anodynes, employed locally in toothache due to caries exposing a nerve filament, are *Aconite*, *Opium* and *Cocaine salts*,—also Carbolic Acid, Creasote, Chloral and Potassium Chlorate. A solution, containing the three first-named, applied on a pledget of cotton, will promptly relieve whenever the nerve is accessible. *Chloral* should never be employed for this purpose, as in solution sufficiently strong to be of any service it is very apt to cause sloughing of the gum, especially if injected thereinto by a hypodermic syringe, as is frequently done by ignorant dentists, who advertise the "extraction of teeth without pain."

Sialogogues, (σίαλον, saliva, ἄγω, to carry off),—are drugs which promote the secretion and flow of saliva and buccal mucus. They may be subdivided into two groups, viz.—

Topical Sialogogues,—which act by reflex stimulation,—including the Acids and Alkalies, Ether, Chloroform, Mustard, Ginger, Pyrethrum, Mezereon, Tobacco, Cubebs, Capsicum, Rhubarb, etc.

General Sialogogues,—which influence the glands or their secretory nerves, viz.—Pilocarpus (Jaborandi), Muscarine, Physostigma, Ipecac, Iodides, Mercurials and Antimonials, etc.

Antisialics,—are agents which diminish the secretions of the salivary and buccal glands. The typical member of this group is *Atropine*, which acts by paralyzing the terminal filaments of the secretory nerves. *Physostigma* antagonizes this paralysis, but in large doses acts also as an antisialic, by lessening the blood-supply to the glands. *Opium* diminishes this secretion among many others, and also lessens the excitability of the reflex centre, by which the secretion is largely stimulated. Others acting locally are—Lime, Soda, Lithia, Magnesia, Borax, Potassium Chlorate, and insipid or nauseous articles of food or medicine.

Refrigerants,—are remedies which impart a sensation of coldness, (*refrigero*, to cool), and thereby allay thirst and restlessness. Among them are the Vegetable and Mineral Acids, (greatly diluted, especially the latter), Ice, Cold Water, Effervescing drinks, Fruit juices, and many diaphoretics.

Gastric Tonics or Stomachics,—increase the appetite and promote gastric digestion. Some act by stimulating the production of the gastric juice,—among which are *Alkalies* before meals;—others by stimulating the local circulation,—as the *Aromatic Oils*, Aromatic Bitters, Alcohol, Ether, etc.;—and several by exciting the activity of the nervo-muscular apparatus of the stomach,—*Nux Vomica*, Arsenic, Hydrastis, dilute Acids, etc. The various *Digestive Ferments*, such as Pepsin, Ingluvin, and dilute HCl Acid, are adjuvants to digestion, and are used to supplement the gastric juice when deficient in quantity or quality.

Acids,—considered physiologically and therapeutically, are medicines which in concentrated form act usually as caustics, to destroy the tissues; but when administered internally in medicinal doses they check the production of glands having acid secretions if coming in contact with the mouths of their ducts,—and increase the production of those having alkaline secretions. Thus, a dilute *acid* given before meals will *check* the production of the *acid gastric juice*, but will *stimulate* that of the *alkaline pancreatic* juice. They should always be largely diluted for internal administration. The principal Acids are Acetic, Citric and Benzoic, from the vegetable kingdom, and Nitric, Phosphoric, Sulphuric and Hydrochloric from the mineral kingdom.

Alkalies, or Ant-acids,—from the same stand-point, are agents which neutralize acids, also act as escharotics on the tissues, and check alkaline and stimulate acid secretions, when in contact with the mouths of the ducts of the glands producing them. Thus, a dilute *alkali* given before meals will *stimulate* the production of the *acid gastric juice*, and if applied to the mouth of the pancreatic duct will *check* the secretion of the *alkaline pancreatic* juice. Alkalies may be subdivided into two groups, named, from their physiological actions,—*Direct Ant-acids*, those which lessen the acidity in the stomach, and *Indirect* or *Remote Antacids*, which have no power over the acidity in the stomach, but are oxidized in the blood, and excreted as Carbonates in the urine and lessen its acidity. The following List of Alkalies comprises the chief members of both groups, and also some which have the actions of both. They should all be largely diluted before administration.

DIRECT ANTACIDS. (*Lessen acidity in the Stomach.*)	REMOTE ANTACIDS. (*Lessen acidity of the Urine.*)
Liquor Potassæ. Liquor Sodæ.	Liquor Potassæ. Liquor Sodæ.
Carbonates and Bicarbonates of K, Na, Li, Mg, and NH_4.	Carbonates and Bicarbonates of K, Na, Li, Mg, and NH_4.
Lime-water. Chalk.	Potassium Acetate, Citrate, Tartrate and Bitartrate.
Calcined Magnesia (Magnesia)	Sodium Acetate and Citrate.
Ammonium Carbonate.	Lithium Citrate.
Aromatic Spirit of Ammonia.	

Emetics (ἐμέω, to vomit),—are agents which cause vomiting. They are subdivided into two groups, viz.—

Local Emetics,—act by irritating the end-organs of the gastric, œsophageal or pharyngeal nerves, and by reflex irritation of the vomiting centre. They include—Alum, Mustard, Salt, the Sulphates of Zinc, Copper and Mercury, Tepid Water in quantity, etc.

Systemic, or *General Emetics*,—act by direct irritation of the vomiting centre in the medulla, through the medium of the circulation. Among them are—Ipecac (Emetine), Apomorphine, Tartar Emetic, Veratrine, Senegá, Squill, etc.,—also Opium and its alkaloids Morphine and Codeine, which cause vomiting as one of their after-effects, though ordinarily classed among the anti-emetics.

Anti-emetics,—are agents which lessen nausea and vomiting, some by a local sedative action upon the end-organs of the gastric nerves, the *Local Gastric Sedatives*;—others by reducing the irritability of the vomiting centre in the medulla, the *General Sedatives*. The principal Anti-emetics are the following named substances, viz.—

Local Gastric Sedatives.	*General Sedatives.*
Arsenic. Bismuth. Ice.	Alcohol. Amyl Nitrite.
Alcohol. Belladonna. Opium.	Nitroglycerin. Chloral.
Alum. Creasote. Ipecac.	Opium. Morphine.
Calomel. Cerium Oxalate. Cocaine.	Hydrocyanic Acid. Bromides.

Of these the most generally efficient is *Cocaine*, in 6-minim doses of a 4 per cent. solution every hour by mouth, for two or three doses.

Carminatives, (*carmino*, to soothe),—aid in the expulsion of gas from the stomach and intestines, by increasing peristalsis, stimulating the circulation, etc. They are also diffusible stimulants. The most important members of this class are as follows, viz.—

Asafetida.
Capsicum.
Cardamom.
Fennel.
Camphor.
Ginger.
Mustard.
Pepper.
Oil of Anise.
Oil of Cinnamon.
Oil of Peppermint.
Oil of Pimento.

Cathartics, or **Purgatives**, (*καθαίρω*, *purgo*, to cleanse),—are agents which increase or hasten the intestinal evacuations. According to their various degrees and modes of action, they are subdivided into several groups, as follows,—

Laxatives, or *Aperients*,—include those which have the most moderate action, of which *Sulphur* is the type, the group including also Magnesia, Figs, Prunes, Tamarinds, etc.

Simple Purgatives,—cause active peristalsis, and some irritation and griping. *Senna* is the type of this group, its list also including Rhubarb, Calomel, Castor oil, Aloes, etc.

Drastic Purgatives,—act still more intensely, causing large watery stools, with much griping pain, tenesmus and borborygmi. *Jalap* is a representative drastic, and the other chief agents of the group are Colocynth, Elaterium, Scammony, Gamboge and Croton oil; all of which are irritant poisons in large doses.

Saline Purgatives,—increase peristalsis, promote osmosis, stimulate the glands, and thus produce free, watery evacuations. The most commonly used Saline is *Magnesium Sulphate*, the well-known "Epsom salts," but the list is a long one, including all neutral salts of metals of the alkalies or alkaline earths, such as the Sulphates of Potassium and Sodium, the Phosphate of Sodium, the Tartrate and Bitartrate of Potassium, the Tartrate of Sodium and Potassium, etc.

Hydragogue Purgatives, (ὕδωρ, water),—include the most active of the drastics and the salines, those which remove a large quantity of water from the vessels. *Elaterium*, Gamboge, Potassium Bitartrate, and Croton oil, are the chief Hydragogues.

Cholagogue Purgatives, (χολη, bile),—stimulate the flow of bile, causing green-colored or "bilious" stools. *Podophyllin* is the typical cholagogue,—the others being Aloes, Rhubarb, Euonymin, Iridin, and the Mercurials.

Intestinal Astringents contract the intestinal vessels, diminishing the exudation therefrom and lessening the fluidity of the fecal discharges. The chief members of this class are the diluted Mineral Acids, and Acetic Acid, Lead Acetate, Silver Nitrate, Alum, Tannic and Gallic Acids, Zinc Oxide, Copper Sulphate, and the Persalts of Iron. Of these, the six last-named are the most powerful, and have a strong *constringing* action upon the intestinal mucous membrane, as well as their ordinary astringent action upon its vessels.

Cholagogues, and **Hepatic Stimulants**,—are two groups of agents which have a marked selective action upon the biliary secretion, hence the term *Cholagogue*, from χόλη, (the bile), and ἄγω, (to bring away). The Hepatic

Stimulants increase the functional activity of the liver-cells, and the amount of bile secreted; while the Cholagogues remove the bile from the duodenum, interfering temporarily with the entero-hepatic circulation, and preventing the reabsorption of bile by the portal vessels. Some Hepatic Stimulants are also cholagogues, others are not;—while the Cholagogues proper act indirectly as hepatic stimulants, by carrying off the bile and thereby urging the liver to secrete more. The following List includes the principal drugs in both groups.

Cholagogues, and Stimulants,—Aloes, Podophyllin, Iridin, Baptisin, Jalapin, Euonymin, Arsenic, Rhubarb, Colchicin, Colocynthin, Sodium Phosphate, Potassium Sulphate, Sodium Sulphate, etc.

Cholagogues,—Mercurous Chloride, (Calomel), Pil. Hydrargyri, Mercury with Chalk, etc.

Hepatic Stimulants,—Mercuric Chloride, (Corrosive Sublimate), Nitro-hydrochloric Acid, Nitric Acid, Benzoic Acid, Sodium Benzoate, Ammonium Chloride, Sodium Bicarbonate, Ipecac, Antimony, Guaiac, etc.

Hepatic Functions, other than the biliary, are stimulated by the following-named drugs, viz.—

The Glycogenic Function is stimulated, and the production of Glycogen increased, by—Sodium Bicarbonate, Amyl Nitrite and Nitro-hydrochloric Acid.

Urea is Increased—by—Arsenic, Antimony, Ammonium Chloride, Iron and Phosphorus.

Hepatic Depressants—lower the functional activity of the liver, certain drugs acting upon certain of its functions, as follows, viz.—

Bile-production Lessened by—Opium, Quinine, Alcohol, Acetate of Lead, and many purgatives.

Glycogen Diminished by—Opium, Morphine, Codeine, Phosphorus, Arsenic and Antimony.

Urea Lessened by—Opium, Morphine, Colchicum, Alcohol and Quinine.

The Pancreas is stimulated to increased secretion by *Æther* given internally, also by galvanism of the gland itself. It is depressed by *Atropine*, or by any agent which induces nausea and vomiting.

Anthelmintics, (*ἀντί*, against, *ἕλμινς*, a worm), are drugs which destroy (vermicides), or expel (vermifuges) worms inhabiting the intestinal canal. The principal vermifuges are the purgatives Castor Oil, Jalap and Scammony,—and the vermicides are classed according to the worm they are each most efficient against, thus,—

Thread-worm, (*Oxyuris Vermicularis*)—Alum, Sulphate of Iron, Lime-water, Quassia, Sodium Chloride, Tannin,—all by enema.

Round-worm, (*Ascaris Lumbricoides*),—Santonin, Spigelia, Chenopodium, Azedarach, internally,—with Senna or Calomel.

Tape-worms, (*Tæniæ, etc.*),—Filix mas, Kamala, Kousso, Granatum, (Pelletierine), Pepo, Turpentine, Chloroform.

AGENTS AFFECTING METABOLISM.

Restoratives,—promote the constructive metamorphosis, and include the Foods, Hæmatics, Tonics and many Stimulants.

Foods,—supply material to renew some structure of the body, or to maintain some vital process; and are derived from the three natural kingdoms,—the vegetable, animal, and mineral,—as Oils and Fats, Sugar, Starch, Gum, Water, Alcohol, Calcium Phosphate, Sodium Chloride, etc.

Hæmatics, (*αἷμα*, the blood),—augment the quantity of hæmatin in the blood, enriching its red corpuscles, and thus restoring the quality of that tissue. They consist principally of Iron and Manganese, and their compounds.

Tonics, (*τόνος*, tension), improve the tone of the tissues on which they have specific action, increasing the vigor of the entire system. Those which act most generally are Strychnine, Quinine, Iron, and the Vegetable Bitters;—those acting more on particular organs will be found enumerated under the titles of the organs or tissues which they affect specifically,—as CARDIAC TONICS, RESPIRATORY STIMULANTS, ETC.

Alteratives,—are agents which *alter* the course of morbid conditions, modifying the nutritive processes while promoting waste, and thus indirectly curing many chronic diseases. *Mercury*, *Iodine* and *Arsenic* are the typical alteratives, the first breaking up new deposits, the second stimulating the absorbent circulation, and the last acting like the first on pulmonary deposits, and being almost specific to the chronic diseases of the skin. Those who denounce the term *Alterative* as "a cloak for ignorance," have never been able to replace it by any more definite designation for a group of agents whose effects upon disease are *facts* of clinical medicine. The principal Alteratives are the three above-named, also Antimony, Aurum, Colchicum, Guaiacum, Sulphur, Stillingia, Xanthoxylum, Calcium Chloride, Phosphorus, Cod-liver Oil, etc. A subdivision may be formed of the—

Resolvents or *Discutients*, (*resolvo*, to unbind, *discutio*, to dissipate),—agents which promote the absorption of morbid products, probably by stimulating the lymphatic system. This group includes Mercury, Arsenic, *Iodine* and Cadmium, also such local measures as Poulticing and Counter-irritation.

The Destructive Metamorphosis of the tissues is promoted by a large number of agents, most of which are classed as *Alteratives* or as *Astringents*,—

he principal ones being the following, viz.—the Alkalies, Vegetable Acids, Metals and their salts, Colchicum, Sulphides, Iodides, Stillingia, Xanthoxylum, Tannic and Gallic Acids, and the Vegetable Astringents.

Metabolism may be diminished by—Alcohol, Glycerin, Oils and Fats, Salicin, Quinine, Resorcin, Chinoline, etc.

Antipyretics, (ἀντί, against, πυρετὸς, fever),—are agents which reduce high body-temperature. This may be done by 5 different actions working upon 2 principal lines, viz.—By—

(*a*) *Lessening Heat-production, by*
(1). Diminishing tissue-change.
(2). Reducing the circulation.

(*b*) *Promoting Heat-loss, by*
(3). Dilating cutaneous vessels, thus increasing heat-radiation.
(4). Promoting perspiration—its evaporation lowering the temperature.
(5). Abstracting heat from the body.

The following list of Antipyretics includes a few for each of the above-named actions, to which the numbers refer in each case, viz.—

Quinine, 1.
Berberine, 1.
Carbolic Acid, 1.
Salicin, 1.
Digitalis, 2.
Aconite, 2.
Alcohol, 1, 3.
Nitrous Ether, 3,4.
Kairine, 1, 4.
Antipyrine, 1, 4.
Thallin, 1, 4.
Antimony, 2, 4.
Cold Bath, 5.
Cold Drinks, 5.
Ice to body, 5.
Wet Pack, 5.

Antiphlogistics, (ἀντὶ, against, φλογίζω, to burn),—include all measures and medicines which reduce inflammation—the principal among them being —*Mercury* and *Opium* for inflammations of serous membranes, *Aconite* and *Antimony* for those of the respiratory apparatus, and *Veratrum Viride* in puerperal metritis. Others are—Digitalis, Ergot, Ipecac, Venesection, Local Depletion, Purgation, Counter-irritation, Cold, and Rest in the recumbent position.

Antiperiodics,—are agents which check the progress of certain periodically-recurring diseases, lessening the severity of their paroxysms and preventing their return,—probably by a toxic action upon the microbes, whose development in the blood by successive crops, is supposed to cause the disease. The great antiperiodic is *Quinine*, next in efficiency is *Arsenic*, and others of less importance are *Salicin* and its derivatives, the other alkaloids of Cinchona, Bebeeru Bark and its alkaloid, Iodine and Eucalyptol.

AGENTS ACTING ON EXCRETION.

Diuretics, (διούρησις, urination,)—are remedies which increase the renal secretion, either by raising the general or local blood-pressure, by stimulating the secreting cells or nerves of the kidneys, or by flushing those organs, and washing them out. They are usually divided into *Refrigerant*, *Hydragogue*, and *Stimulant Diuretics*, according to their physiological action;—or they may be classified according to the different purposes for which they are employed. Both these classifications are fully described under the title DIURETICS, at the end of the book.

Renal Depressants, lower the activity of the renal cells, thereby lessening or suspending the urinary secretion. The drugs which act thus are *Morphine*, *Quinine* and *Ergot*. Instead of acting as a diuretic *Digitalis* may stop the secretion of urine, by so stimulating the vaso-motor centre as to greatly contract the renal vessels, and arrest the renal circulation (Brunton). This it might do if a preparation were used which was deficient in Digitoxin or Digitalein, the dilators of the renal arteries: (see under DIGITALIS.) The same is true of *Caffeine* and *Strychnine*, both diuretics,—hence it is well to combine these with other diuretics which dilate the renal vessels, as the Nitrites, (Nitrous Ether, etc.), and Alcohol. Digitalis contains in itself the power of doing both these actions, and hence it is the ideal diuretic.

Urinary Alkalinizers—when taken internally cause the urine to have an alkaline reaction. They include the Alkalies, especially the salts of Potassium and Lithium, but excepting Ammonia, which is broken up in the organism, and Sodium salts, which are not so efficient as other agents, being partly excreted by the bile and the bronchial mucus, and partly locked up in the system as the neutral chloride, while the urate of sodium is insoluble.

Urinary Acidifiers,—are very few, comprising only *Benzoic Acid*, Salicylic Acid, and Vegetable Acids in excess;—also excess of proteids, sugar and starch, in the food, and certain wines and spirits. The Mineral Acids, being excreted as neutral sulphates, chlorides, phosphates, etc., have little or no influence on the acidity of the urine.

Vesical Tonics—increase the tone of the muscular fibres in the wall of the bladder, and consequently the contractile power of that organ. The chief members of this class are *Strychnine*, Cantharis, Belladonna, and the Bromides; all of which, carried to excess, will paralyze these same fibres by over-stimulation. This is particularly true of the Bromides.

Vesical Sedatives,—lessen irritability of the bladder, decreasing the desire to micturate, and relieving vesical pain. The most important are—*Opium*, Belladonna, *Hyoscyamus*, *Cannabis*, Stigmata Maidis, Calcium Carbonate, Buchu, Uva Ursi, Pareira, Copaiba and Cubebs; also Barley-water, Linseed tea, and other mucilaginous drinks.

Urinary Sedatives,—act in a sedative manner upon the whole extent of the urinary tract, through the medium of the urine, which, being charged with them, brings them into contact with the genito-urinary mucous membrane. Some of them may be applied locally as far as the urethral and vesical mucous surfaces, the portion above being inaccessible to direct local medication. Such are *Potassium* and Lithium Salts to lessen the acidity of the urine,—Cubebs, *Copaiba,* and Oleum Santali as antiseptics and astringents, in cystitis and urethritis; also *Eucalyptus* and Corn Silk for the same purpose;—and urethral and vesical injections of solutions containing Alum, *Boracic Acid,* Acetates of Lead and Zinc, *Nitrate of Silver,* etc., agents which may also be applied to the urethra through the medium of gelatin pencils (Bougia) medicated with them.

Antilithics, and **Lithontriptics,** (*ἀντί,* against, *λίθος,* a stone, *τρίβω,* to wear down),—are agents which are supposed to prevent the formation of concretions in the ducts, (antilithics), or to dissolve said concretions when formed, (lithontriptics). The efficiency of any agents, for the purposes named, is more than doubtful. Those recommended for the various concretions are as follows, viz.—

For Uric Acid Calculi,—Distilled Water, Potash or Lithia, and salts of these metals, Magnesium Citroborate, Potassium Tartraborate.

For Phosphatic Calculi,—Benzoic Acid and the Benzoates, especially Ammonium Benzoate, Dilute Nitric Acid.

For Oxalate of Calcium Calculi,—Dilute Nitro-hydrochloric Acid, Carbonic Acid Waters, Lactic Acid, for the digestive disturbance.

For Biliary Calculi,—Ether and Turpentine, (Durande's Solvent), Sodium Salts, Castile Soap, Alkaline Waters, especially Vichy.

A Diluent—is an indifferent substance which, being absorbed, passes through the body, diluting its fluids and excretions. *Water* is the only true diluent, whatever form it may be disguised in, as teas, weak fluid foods, acidulated drinks, etc.

Diaphoretics and **Sudorifics,** (*διαφορέω,* to carry through;—*sudor,* sweat, *facio,* to make),—increase the action of the skin, and promote the secretion of sweat, those which act most energetically being designated by the latter title.

Simple Diaphoretics, which enter the circulation and stimulate the sudoriferous glands during their elimination,—as Jaborandi, Spirit of Mindererus (Liq. Ammonii Acetatis), Sweet Spirit of Nitre (Spiritus Etheris Nitrosi), Alcohol, Salicylates, Camphor, Sulphur, etc.

Nauseating Diaphoretics, which act by producing relaxation and dilatation of the capillaries,—as Tartar Emetic, Ipecacuanha, Dover's powder, Lobelia, Tobacco, Baths, Heat, etc.

Refrigerant Diaphoretics, which act by reducing the force of the circulation,—and perhaps also by a specific action on the sweat-centre in the medulla, —as the Potassium and Ammonium salts, Aconite, Veratrum, Cocaine, Tobacco, Jaborandi, Ether, Nitrites, etc.

Anhidrotics, (*ἀν*, without, *ἱδρως*, sweat),—are agents which check perspiration, acting in either of three ways, the reverse of those for the diaphoretics. The most energetic member of this class is *Atropine*, and others are Muscarine, Ergot, Zinc Salts, Acids, locally, Cold, locally, Opium, etc. The latter checks perspiration in small doses, but in large doses promotes it.

AGENTS ACTING ON THE GENERATIVE APPARATUS.

Aphrodisiacs, (Αφροδίτη, Venus),—are agents which stimulate the sexual appetite and function, by direct or reflex action on the genital centres in the brain and spinal cord. Such are Nux Vomica, Cannabis, Cantharis, Phosphorus, Aurum, Alcohol, Opium (at first), Camphor (at first), Ergot, Iron, Bitter Tonics, and Meat Diet,—the last three being indirectly aphrodisiac, as are all measures which promote the general nutrition of the body.

Anaphrodisiacs,—diminish the sexual appetite and lower its functional power, either by depressing the special nervous apparatus or by decreasing the local circulation. The chief anaphrodisiacs are—Tobacco, Cocaine, Belladonna, Gelsemium, Lupulin, Camphor (at last), Opium (at last), Bromides, Iodides, all nauseants, purgation, cold, (locally), vegetable diet. A drop of a 4 per cent. solution of Cocaine upon the glans penis will destroy all erection-power for a quarter to half an hour.

Emmenagogues, (*ἐμμηνια*, the menses, *ἀγω*, to move),—are measures and remedies which restore the menstrual function. They may be divided into—

Direct Emmenagogues,—which stimulate the uterine muscular fibre, and are *Ecbolic* in large doses,—as *Ergot*, Rue, Savine, Apiol, Borax, Petroselinum, Quinine, Pulsatilla, Myrrh, Cantharis, *Potassium Permanganate*, Oxalic Acid, *Indigo*, etc.

Indirect Emmenagogues,—which act by improving the blood and toning up the nervous system;—among which are—*Iron*, Manganese, *Mercuric Iodide*, Strychnine, Cinnamon, Aloetic purgatives, Cod-liver Oil, Hot Hip-baths, Leeching the genitals, Rubefacients to the thighs, Tonic remedies, etc.

Oxytocics or **Ecbolics**, (*ὀξύς*, quick, *τόκος*, childbirth; *ἐκβολή*, abortion),—are agents which produce abortion, by stimulating the gravid uterus to contract upon its contents, perhaps by direct irritation of the uterine centre in the cord. The chief oxytocics are—*Ergot*, Ustilago, Savine, Quinine, *Borax*, Cotton-root Bark, Oil of Rue, Pilocarpine, *Viscum flavescens*, etc.,—but any violent purgative, or gastro-intestinal irritant, may produce abortion by reflex action.

It is in this way that all the *Volatile Oils* act as abortifacients, also Tansy, Colocynth, Pennyroyal, and many other drugs used by women for that purpose; all of which are dangerous to the woman's life, in doses large enough to excite uterine action. As for the physician who should prescribe such agents for the purpose indicated, he would stand on a par with the drunken husband who kicks his pregnant wife in the abdomen. Both operators initiate uterine contractions in the same manner, namely—by reflex action from a powerful impression upon the woman's system,—made,—in the one case, by an irritant *boot* with a *brute* behind it,—in the other case by an irritant *drug* with either a *scoundrel* or a *fool* behind it.

Uterine Depressants—lower the activity of the nervo-muscular apparatus controlling uterine contraction. The chief members of this group are—*Opium*, Cannabis, Bromides, Chloral, Chloroform, Tartar Emetic, Tobacco, Copper Sulphate, and all Emetics,—also Viburnum prunifolium, Piscidia erythrina, etc.

Uterine Tonics and **Alteratives**,—are remedies which are considered to have these actions upon the nutrition and functions of the uterus; concerning which there is much variance of opinion among authorities. The following list, however, contains those which are generally acknowledged to have considerable value in uterine therapeutics, viz.—

Uterine Tonics.

Potassium Bromide. Pulsatilla.
Potassium Chlorate. Cimicifuga.
Helonias dioica. Savine.
Iodine, and Astringents, (locally).
Viburnum Opulus, and V. Prunifolium.

Uterine Alteratives.

Iodine. Iodoform.
Iodized Phenol, or Carbolated Iodine.
Glycerin. Hydrastis.
Silver Nitrate. Galvanism.

Galactagogues, (*γάλα*, milk, *ἄγω*, to bring away),—are medicines which are supposed to increase the lacteal secretion. The value of many of these is very doubtful,—probably the most efficient being *Pilocarpus* (Jaborandi). Others are—the leaves of the Castor-oil plant, (Ricinus communis), locally,—Black Tea, Anise, Fennel, and Potassium Chlorate. Milk, Beer or Porter, as beverages, are thought to help the secretion. Anæmia must be corrected, sore nipples attended to, good food supplied, and tonics if needed.

Galactophyga, (*φευγω*, to shun),—are remedies which arrest the secretion of milk. The most efficient is *Belladonna* or its alkaloid, *Atropine*, locally and internally. Others are—Potassium Iodide, Colchicum with Magnesium Sulphate, Camphor, Tobacco, Sage, Quinine, Tannin, etc.

AGENTS ACTING ON THE SKIN.

Irritants,—are substances, which, when applied to the skin, produce more or less of vascular excitement. When employed to excite a reflex influence on a part remote from their site, they are called COUNTER-IRRITANTS, and may be sub-divided into the following groups, viz.—

Rubefacients, (*ruber*, red, *facio*, to make),—those which cause redness (congestion) of the skin,—as *Mustard*, Camphor, Iodine, Capsicum, Turpentine, Ammonia, Pitch, etc. The stronger agents of this subdivision are capable of destroying the tissue if left in contact with it for too long a time.

Epispastics, Vesicants, or Blisters, produce decided inflammation of the skin, and the outpouring of serum between the epidermis and the derma. *Cantharides* is the agent most used for this purpose, but Mezereon, Euphorbium, etc., are equally efficient.

Pustulants,—affect isolated parts of the skin, as the orifices of the glands, etc., giving rise to pustules. Such are *Croton Oil*, Tartar Emetic, Ipecacuanha and Silver Nitrate.

Escharotics or **Caustics**, (ἐσχάρα, a slough, καίω, to burn),—are substances which destroy the life of the tissue to which they are applied, either by abstracting its water,—as *Sulphuric Acid;* or by corrosive oxidation,—as *Bromine.* The chief caustics are Potassa, Lime, Arsenious Acid, Zinc Chloride, Silver Nitrate, Corrosive Sublimate, Mercuric Nitrate, Mineral Acids, Bromine, Sulphates of Zinc and Copper. Chromic Acid is one of the most efficient, but must be carefully used, it being a violent poison.

Astringents, (*ad*, to, *stringo*, to bind),—produce contraction of muscular fibre, and condensation of other tissues, also lessen secretion from mucous membranes. *Remote Astringents*, act on internal organs through the circulation, as Gallic Acid, Sulphuric Acid and Acetate of Lead. *Local Astringents* affect the part to which they are applied, as Tannic Acid, Alum, salts of Bismuth, Lead, Copper, Zinc, and Cadmium, the per-salts of Iron, the Mineral Acids, Galls, Kino, Catechu, and other plants containing Tannic Acid.

Styptics and **Hemostatics**, (στύφω, to contract;—αἷμα, blood, στάσις, a standing),—are agents which arrest bleeding; *Styptics* being applied locally, and *Hemostatics* administered internally, for the same purpose. Some act mechanically, by promoting clot-formation in the mouths of the bleeding vessels,—others by causing the vessels themselves to contract, and thereby check the flow of blood. The principal members of this class are the following-named, to wit,—

Styptics,—Acids, Alum, Ferric Chloride and Sulphate, Zinc Sulphate, Lead Acetate, Silver Nitrate, Matico, Cold, Spider's Web, Tannic Acid and all the Vegetable Astringents.

Hemostatics,—the dilute Mineral Acids, especially Sulphuric, Gallic Acid, Ergot, Digitalis, Hamamelis, Ipecacuanha, Lead Acetate, and Oil of Turpentine.

Emollients and **Demulcents**, (*emollio*, to soften, *demulceo*, to soothe),—are substances which soothe and protect tissues to which they are applied. *Emollients* act as external demulcents, being used upon the cutaneous surface, to soften and relax the part, dilate the vessels, diminish tension, and protect from the air or from friction. *Demulcents* are generally of oleaginous or mucilaginous character, employed on the mucous membranes for similar purposes. The chief agents comprised in these two groups are as follows,—

Emollients.	*Demulcents.*
Petrolatum, (Vaseline).	Isinglass. Bland Oils.
Soap Liniment. Starch.	Marsh-mallow. Honey.
Adeps, (Lard). Glycerin.	Tragacanth. Almond Oil.
Cacao-butter, (Ol. Theobromæ).	Acacia. Cetraria. Starch.
Flaxseed Poultices. Olive Oil.	Liquorice. Glycerin. Olive Oil.

Protectives—are articles employed to cover an inflamed or injured part, and to protect it from the air, water, friction, etc. *Collodion* and *Gutta-percha* are those in general use, but Cotton Wool, and certain plasters, the Adhesive, Lead or the Soap Plaster, may also be employed.

AGENTS ACTING ON MICROBES, PARASITES, ETC.

Antizymotics, (*ἀντὶ*, against, *ζυμωσίς*, fermentation),—are agents which arrest all fermentative processes, not only those due to the action of *Organic Ferments*, (diastase, pepsin, ptyalin, etc.,), but also those depending on *Organised Ferments*, (the yeast-plant, bacteria, cocci, etc.). They may be divided into two groups, viz.—

Antiseptics, (*ἀντί*, against, *σηπτικὸς*, putrefaction),—are those which retard or prevent septic decomposition, by destroying the bacilli which produce it, or by arresting their development. The principal Antiseptics are—*Potassio-Mercuric Iodide*, Mercuric Chloride, Iodide and Oxide, Mercurous Chloride, Hydrogen Dioxide, Potassium Permanganate, Hydronaphthol, Sulphurous Acid, Sulphites and Hyposulphites, Salicin, Quinine, Thymol, Carbolic Acid, Creasote, Alcohol, Eucalyptol, Borax, Chlorine, Chlorides and Chlorates.

Disinfectants,—are those which destroy the germs of infectious diseases. They act in several different modes;—some are *Oxidizants*, as Lime, Chlorine, Iodine, Bromine, Heat, 230°–250° F., etc.; others are *Desulphurants*, as Ferric Sulphate, Lime, etc.; and others are *Absorbents*, as Charcoal, Dry Earth, etc. Many members of this group have the additional property of destroying foul smells, and are called *Deodorants*, such being Ozone, Earth, Lime, Charcoal, Ferrous Sulphate, Chlorine and Sulphurous Acid Gases, etc.

FERMENTATION is a general name for certain processes of decomposition, during which certain carbon compounds called *Ferments* act upon other carbon compounds, as on their food,—splitting these latter up, setting free their elementary constituents, and thereby leading to the formation of still other carbon compounds, by the re-arrangement of the freed molecules. These processes are of two kinds, viz:—

(1)—Those in which water is taken up, (hydration),—chiefly carried on by enzymes.

(2)—Those in which O is transferred from the H to the C association, as in lactic and alcoholic fermentation, and the putrefactive processes,—and are chiefly carried on by the agency of organized ferments.

THE FERMENTS producing these fermentative changes are also carbon compounds, and are divisible into two groups, viz:—

Enzymes, or *Organic Ferments*,—have no definite structure, and are unorganized, *i. e.*, not living,—as Diastase, Ptyalin, Pepsin, etc.

Organized Ferments,—are minute, living organisms, as the moulds, yeast-plant, bacteria, and other members of the Protophytes, the lowermost class of plants, which, in the course of their life history, split up the carbon compounds in which they live, appropriating some part of their elements.

ANTIZYMOTIC DRUGS are drugs which arrest or inhibit these fermentative processes, either by destroying or by rendering inactive the causative ferments.

Parasiticides, (παρασίτος, a parasite, *cædo*, to kill),—destroy the various animal and vegetable organisms which live upon the human body. They are generally employed in the form of lotions, ointments or oleates,—and include the following articles, viz.—*Sulphur*, Sulphides, Sulphurous Acid, Iodine, Iodide of Sulphur, Mercury and its Chlorides, Nitrate, Oxide, and Ammoniated Mercury, Carbolic Acid, Storax, Petroleum, Staphisagria, Balsam of Peru, etc.

AGENTS ACTING UPON EACH OTHER.

Antidotes, (ἀντὶ, against, δίδωμι, to give),—are agents which act upon poisons in such a manner as to alter their composition, rendering them more or less innocuous, and so *preventing* their toxic action being exerted upon the organism. Antidotal action takes place in the alimentary canal, upon such portion of the poison as is unabsorbed, and is applicable to vegetable as well as to mineral poisons. *Antidotal Measures* are such medicinal or mechanical processes as tend to remove a poison from the body, either before or after the use of an antidote; and include Emesis, the use of the Stomach-pump, Purgation, etc. The term *Antidotal Treatment* covers the employment of both antidotes and antidotal measures, and is often used in a still wider sense, namely, to mean all the treatment of a case of poisoning, including the use of Antagonists as well as that of Antidotes.

Antagonists, are agents which directly oppose each other, in some or all of their physiological actions, and therefore may be used, one against the other, in a case of poisoning by either, to *counteract* its effects upon the organism, after it has been absorbed, and when, therefore, the time for an andidote has passed. Antagonistic action takes place in the blood and tissues, and is applicable almost entirely to vegetable poisons. *Antagonistic Measures* are such mechanical procedures as tend to the same end, viz.—the antagonism of the effects of poisons;—and include Artificial Respiration, Faradism of certain muscles, Douching, Motion, Rest, etc.

For example, in a case of poisoning by *Digitalis*, the antidote would be *Tannic Acid*, because it forms with the active principle of Digitalis a compound, (Tannate of Digitalin), which is not readily soluble, and is therefore comparatively innocuous. But as this new compound is not wholly inert, it must be removed from the body;—and an antidotal measure is employed, viz. —*evacuation of the stomach*,—which may be accomplished by the administration of *Zinc Sulphate* or any other emetic, or by the use of a stomach-pump.

But, supposing that sufficient time had elapsed, between the ingestion of the poison and the administration of the antidote, for some degree of absorption to have occurred, and that we observe evidences of the presence of the poison in the blood,—we must resort then to an antagonist. Now, *Aconite* and *Morphine* antagonize the cardiac action of Digitalis, but *Saponin* and *Senegin* are its most complete antagonists, their counter-action extending throughout the whole range of its physiological effects. Having made our selection, we would use one of these agents cautiously, being careful not to substitute its toxic action for that of the original poison; and we would aid its influence by enjoining absolute *Rest* in the recumbent posture, which is an antagonistic measure of great importance against the effects of Digitalis upon the heart.

In most cases of poisoning by powerful vegetable drugs assistance is not obtained until absorption has proceeded so far that antidotes are of little value, and the chief reliance must be placed upon the appropriate physiological antagonist, and such supporting measures as will sustain the action of any vital function which shows signs of failing. In this way we endeavor to maintain life until the excretory functions of the organism have had time to eliminate the poison by way of the natural channels.

Under each title in the following pages its appropriate Antidotes and Antagonists are given, for every substance which is recognized as a poison.

RESTORATIVE AGENTS.

This division of the Materia Medica includes all agents which in any way promote the constructive metamorphosis of tissue,—such as the Digestion-ferments, which aid digestion; the Foods, Tonics, Hæmatics or blood-restorers, and many substances generally known as Stimulants.

DIGESTION-FERMENTS.

The **Digestion-Ferments** include the three animal products named Pepsin, Pancreatin and Ingluvin, and Papain, from the vegetable kingdom.

Pepsin is an organic ferment which constitutes the digestive principle of the gastric juice of animals, and is usually obtained from the mucous membrane of the pig's stomach.

* *Pancreatin* is an organic substance obtained from the pancreas of animals, and contains four ferments, viz.—Trypsin, Pancreatic Diastase, an Emulsifying and a Milk-curdling ferment.

* *Ingluvin* is obtained from the gizzard of the domestic fowl, and owes its digestive activity to a peculiar bitter principle.

* *Papain*, *Papaw*, or *Papayotin*, is a ferment obtained from the milky juice of Carica Papaya, a South American fruit-tree. It is too powerful a digestor to be used internally, as it might digest the gastric mucous membrane itself.

Preparations. Only two are official, viz.—

Pepsinum Saccharatum, Saccharated Pepsin,—is Pepsin from the stomach of the hog, mixed with powdered Sugar of Milk. Dose, gr. v–xxx, after meals.

Liquor Pepsini, Solution of Pepsin, Liquid Pepsin,—has of the preceding 40 parts, with HCl 12, Glycerin 400, in Water to 1000 parts. Dose, ʒ j–ʒ ij.

**Extractum Pancreaticus*, or *Pancreatin*, is one of several trade preparations of the pancreatic principle. It is supposed to contain all four of the pancreatic ferments. Dose, gr. iij–v, in capsule, pill or tablet. It is also put up with three times its weight of Sodium Bicarbonate, as "Peptonic Milk Powder" or "Peptonizing Tubes,"—for the preparation of Peptonized Milk.

**Ingluvin*,—from the gizzard of the fowl. Dose, gr. x–xxx.

Every manufacturer of digestion-ferments has his own preparation of Pepsin and Pancreatin, and his peculiar name therefor. These various products vary considerably in their properties. A few of the most prominent are as follows, viz.—

**Lactopeptine*,—a powder, said to contain Pepsin, Diastase, Pancreatin, Lactic and Hydrochloric Acids. Dose, gr. v–xv.

**Jensen's Crystal Pepsin*, in yellowish, translucent scales, soluble in water, and claimed to be pure pepsin without admixture. Dose, gr. j–iij.

**Pepsine in Scales* (Fairchild), is a similar preparation, gr. j is claimed to digest 1000 grains of albumen in 4 hours. Dose, gr. j–iij.
**Essence of Pepsine*,—a solution similar to the official Liquor. Dose, ʒ j.
**Liquid Pancreopepsine*,—is said to contain Pepsin, Pancreatin, Lactic, Hydrochloric and Phosphoric Acids. Dose, ℥ ss–j, after meals.
**Diastasic Essence of Pancreas*,—for starchy foods. Dose, ʒ j–ij.
**Trypsin*, the fibrin-digesting ferment of the pancreatic juice. Is used in aqueous solution, ʒ ss to the ℥, with gr. x of Sodium Bicarb., locally.

Scheffer's Process is the standard process for the preparation of pepsin. The mucous membrane of a pig's stomach is scraped off and digested in a solution of H Cl, and the Pepsin is then precipitated by adding a solution of Na Cl. Ten grains of Scheffer's Saccharated Pepsin, with gtt. x of dilute H Cl, and ℥ j of water, will dissolve 200 grains of albumen in from five to six hours, at 100° Fahr.

Incompatibles. Alkalies and many mineral salts precipitate pepsin. Alcohol destroys its activity. Alkalies promote the action of pancreatin.

Physiological Actions. *Pepsin* and *Ingluvin* digest the nitrogenous principles of the food (albumen, casein, fibrin, etc.) converting them into peptones for assimilation; in which they are materially aided by Lactic and H Cl Acids. *Pancreatin* does the same, and in addition, with the aid of an alkali, it emulsifies fats and oils. Pepsin is an essential element of the gastric juice, and will digest pancreatin, which probably therefore never passes into the duodenum in its own character. *Trypsin*, unlike Pepsin, will dissolve mucin, and like Pepsin it is inert towards nuclein, horn and amyloid matter.

Therapeutics. *Pepsin* is indicated in atonic dyspepsia, the apepsia of infants, gastralgia, anæmia, chlorosis, gastric ulcer and cancer, diarrhœa of infants, and the vomiting of pregnancy. It is added to nutritive enemata, the rectum not being a digestive organ; and is injected into the substance of morbid growths which are homologous to the tissues for their destruction, especially fatty tumors. *Ingluvin* is particularly useful against vomiting, and has been found very efficient in the vomiting of pregnancy. *Pancreatin* is used to assist the digestion of oils and fats, and should be administered 2 or 3 hours after meals; whilst Pepsin is best given near meal-time. The various Pancreatic preparations are used to partially digest (peptonize) milk, gruel, soups and other foods, before administration, in cases where there is great digestive debility. These peptonized foods may be administered by rectal injection (enemata), as well as by the mouth, and are invaluable in wasting diseases, in intestinal dyspepsia, and in convalescence from acute affections. A spoonful of Liquor Pancreaticus, taken directly after a dose of Cod-liver

Oil, will prevent the disagreeable eructations which so frequently follow, and will assist in the digestion of the oil. *Trypsin* is used with real benefit as a solvent of the diphtheritic membrane, but requires to be thoroughly and frequently applied. *Papain* is a powerful digestor of fibrin, acting in solutions of any reaction, and at higher temperatures than Pepsin will. It is a rapid solvent of false membranes and of intestinal worms. It has been injected into tumors for their destruction, and successfully, but with much pain and considerable febrile reaction. It is not used internally.

ACIDUM LACTICUM,—Lactic Acid.

Properties of Lactic Acid. It is a syrupy, oily liquid, of specific gravity 1.212, and difficult to obtain pure. It should be given in quantity sufficient to render water distinctly sour, and always well diluted. It is found in the stomach, being a product of the food, and combines with bases in the blood, forming lactates, which being oxidized are converted into carbonates. Dose, ʒ ss–℥ ss, well diluted.

Physiological Actions. It aids digestion, and promotes the appetite; in large doses causing flatulence and much epigastric pain. Injected into the peritoneal cavity of animals, it excites endocarditis, and given in diabetes it has caused acute rheumatism and rheumatic endocarditis. Hence its supposed causation of acute rheumatism, when in excess and free in the blood.

Therapeutics. It is used in diabetes, atonic dyspepsia, oxaluria, and in the lithic and phosphatic diatheses when due to imperfect digestion and assimilation. As a solvent of false membrane in croup and diphtheria, it is unquestionably of great service, but is difficult of application, as in a solution of sufficient strength to act upon the membrane it causes considerable smarting pain. In chronic cystitis it arrests the ammoniacal decomposition of the urine.

MINERAL ACIDS.

Preparations and Doses.

Acidum Sulphuricum Dilutum, strength $\frac{1}{10}$, gtt. iij–xv, well diluted.

Acidum Sulphuricum Aromaticum, Elixir of Vitriol, strength $\frac{1}{5}$, gtt. v–xx, well diluted. Contains sulphuric acid, alcohol, ginger and cinnamon. Is not an acid, but an ether, from the reaction of the acid on the alcohol.

Acidum Hydrochloricum Dilutum, strength $\frac{6}{13}$, gtt. iij–v, well diluted.

Acidum Nitricum Dilutum, $\frac{1}{6}$, gtt. iij–x, well diluted.

Acidum Nitro-hydrochloricum Dilutum, Nit. Ac. 4, HCl 15, Aq. 76:—gtt. iij–x, well diluted.

Acidum Phosphoricum Dilutum, strength ⅕, gtt. iij–x, well diluted.

An average dose of all the dilute mineral acids is gtt. iij–x.

Physiological Actions. The strong acids are *escharotics*, abstracting the water from the tissues, combining with the bases, destroying the protoplasm, and are very diffusible. Sulphuric carbonizes (black); Nitric tans (yellow). The dilute acids act in the stomach chemically. *Secretion* is promoted by Nitric, lessened by Sulphuric, Hydrochloric acid acting thereon between the other two. *To mouths of ducts* having an acid secretion, they check the flow; to those of alkaline secretion they promote it (*e.g.* bile, pancreatic, juice, etc.). *Fermentation* is checked by the mineral acids. *Bowels* are constipated by Sulphuric, relaxed by Nitric acid.

As these agents are synergistic to pepsin, they at first aid digestion; but if continued they lessen the production of gastrie juice, and so impair digestion. Given before meals in small doses they will relieve excessive acidity of the stomach, by checking the production of the acid gastric juice.

Poisoning by the Mineral Acids is treated by Alkalies, as washing soda, soap-suds, etc., to neutralize the acid; cautiously empty the stomach; give oil, albumen, or milk, to protect the mucous membrane. Stimulants, opium, ammonia intra-venously, to combat the resulting depressed condition of the vital powers.

Therapeutics. The mineral acids are used in—

Atonic Dyspepsia,—small doses of Hydrochloric acid with pepsin, given after meals, except where there is acidity of the stomach.

Acidity,—Hydrochloric or Phosphoric in small doses before meals.

Oxaluria,—Nitric or Nitro-hydrochloric. *Lithæmia*, Nitric acid.

Diarrhœa,—when profuse secretions, Sulphuric acid with Opium.

Choleraic Diarrhœa and Dysentery,—Sulphuric with Opium, or with Magnesium sulphate, is found very serviceable.

Fevers,—especially typhoid,—Hydrochloric acid preferred.

Lead Poisoning,—Sulphuric, to form the insoluble sulphate of lead.

Hemorrhoids.—Sulphuric; also for hemorrhage from lower bowel.

Hemorrhages,—Sulphuric is undoubtedly effective in uterine hemorrhage from fibroids, and in other hemorrhages at points distant from the stomach; also sometimes in purpura hemorrhagica.

Chronic Hepatic Disorders,—Nitro-hydrochloric acid in all forms of liver affections due to malaria, internally, and locally as a bath.

Intermittent and Remittent Fevers,—Nitric acid in full doses, is beneficial.

Aphonia of Singers,—Dilute Nitric acid in 10-drop doses, has proved efficient.

Phthisis,—Aromatic Sulphuric acid for the sweats.

Local Uses. They are employed against—

Ulcers,—Fuming Nitric acid as an escharotic, also in *Gangrene*.

Hemorrhoids, of the bleeding, strawberry-pile kind,—Fuming Nitric acid.

Diseased Joints,—Counter-irritation by Brodie's liniment, composed of Sulphuric acid one-fourth, Olive oil, three-fourths.

Uterine Diseases are often treated with fuming Nitric acid, locally applied.

OILS AND FATS.

Fixed Oils and Fats used in Medicine are as follows—

Adeps,—Lard.
Oleum Adipis,—Lard Oil.
Sevum,—Suet.
Cetaceum,—Spermaceti.
Oleum Olivæ,—Olive Oil.
Oleum Sesami,—Bennè Oil.
Ol. Amygdalæ Expressum,—Almond Oil.
Oleum Theobrômæ,—Cacao-butter.
Oleum Lini,—Flaxseed or Linseed Oil.
Oleum Morrhuæ,—Cod-liver Oil.
Oleum Gossypii Seminis,—Cotton-seed Oil, "Olive Oil."
* *Lanolinum*, Lanolin,—Sheep's Wool Fat.

[The two other official fixed oils, Oleum Ricini and Oleum Tiglii, are used for their cathartic qualities, and are therefore classed with the Evacuants, in another place.]

Composition. All the oils (except Cod-liver Oil) contain olein, stearin, and margarin, in varying proportions, the olein giving fluidity, the stearin solidity. Olein, Stearin, and Margarin are respectively oleate, stearate, and margarate of glycerin. *Cod liver Oil* consists chiefly of olein and margarin, with a peculiar principle,—Gaduin,—also propy′lamin, bile constituents, and traces of sulphuric and phosphoric acids, bromine, iodine, phosphorus, iron, lime and magnesia. Three kinds are sold,—the pale, the light-brown, and the dark. The pale oil is considered to be the purest. *Linseed Oil* contains much vegetable albumen, which coagulates on exposure to the air, making it a drying oil. Its olein furnishes linoleic acid, instead of oleic, when saponified. *Lanolin* is a cholesterin fat obtained from the washings of sheep's wool. It contains 25 to 30 per cent. of water, and unites readily with 110 per cent. of its own weight of water. It differs from all other fats, in resisting saponification, the action of water, and the tendency to rancidity. It is perfectly neutral as a base, and readily penetrates the integument, carrying with it any medicament it is charged with. *Cotton-seed Oil* is used largely in place of Olive Oil, and is sold as Olive Oil in the shops. Hence it was made official, and its use directed for many pharmacopœial preparations.

Physiological Actions. Fats in small quantity are necessary to the digestion of nitrogenous food (Lehmann), and form the molecular basis of the chyle. They are prepared for absorption by the pancreatic juice and the bile, especially by the latter. Fat is an essential constituent of the products of tissue formation, whether physiological or pathological, and is the chief material concerned in the formation of force. After oxidation it is excreted as carbonic acid and water. Locally applied fat reduces the body temperature.

Therapeutics. Locally, by inunction, oils and fat may be used in the scaly diseases of the skin, and in chronic wasting diseases; also in rickety and scrofulous children, and in febrile disorders, particularly the desquamative stage of scarlatina. *Cod-liver Oil* may also be used by inunction, in the foregoing disorders, but it is best administered internally, and in the following diseases, viz.—

Chronic Forms of Phthisis.	Strumous Skin diseases.
Chronic Bronchitis and Emphysema.	Syphilo-dermata.
Chronic Rheumatic Disorders.	Neuralgia, Chorea, Epilepsy.
Atheroma of the Arteries.	Diarrhœas of strumous subjects.

Cod-liver Oil is best administered in small doses, a teaspoonful thrice a day for an adult, in black coffee, beer or lemon-juice. One drop of the Essential Oil of Eucalyptus will extinguish the odor and taste of 100 drops.

PHOSPHORUS.

Preparations.

Oleum Phosphoratum, Phosphorated Oil; strength $\frac{1}{100}$, ♏j–v.
Pilulæ Phosphori, Pills of Phosphorus; each contains gr. $\frac{1}{100}$ of Phos.
* *Tinctura Phosphori* (Thompson's); each ʒ contains gr. $\frac{1}{33}$.
* *Tinctura Phosphori* (Bellevue Hosp.); each ʒ contains gr. $\frac{1}{12}$.
Zinci Phosphidum, Phosphide of Zinc; gr. $\frac{1}{50}$–$\frac{1}{30}$. Is irritant.

Physiological Actions. Phosphorus *in small doses* is a stimulant to the growth of the bones, to the genital function, and to the brain, circulation and stomach. It aids digestion by irritating the end organs of the stomach nerves, and causes eructations of phosphide of hydrogen. Its fumes cause necrosis of the upper or lower jaw bones, especially in those whose teeth are decayed; but this may be prevented by the inhalation of the fumes of old acid turpentine. *In poisonous doses* it is a powerful gastro-intestinal irritant, causing vomiting and purging, with great depression; reaching the blood as phosphorus it destroys the red corpuscles, causing acute hemorrhages from fatty degeneration of the arterial walls, rapid steatosis of the stomach, liver and heart, with deep jaundice; then delirium, convulsions, coma and death, generally from gradual failure of both respiration and circulation.

Antagonists. Sulphate of Copper is the best emetic, (forming a nearly insoluble phosphide of copper), 3-grain doses in dilute solution every five minutes until emesis. Hydrated Magnesia as a quickly acting purgative. Lime water or Charcoal to prevent its action on the tissues. The antidote is the common *Commercial Oil of Turpentine* (Bartholow), crude French Acid Turpentine (Wood), which has been exposed to the air for some time. Transfusion has been efficacious in repairing the blood. No oils or fats, as they dissolve phosphorus and promote its absorption.

Acute Phosphorus Poisoning most resembles Acute Yellow Atrophy of the Liver; so much so that it is generally impossible to distinguish between them.

Therapeutics. Phosphorus is used in—

Chronic Nervous Exhaustion, when the nerve centres are implicated.
Neuralgia requires large doses, gr. $\frac{1}{12}$, or ʒj of the Bellevue Tincture.
Anæmia, pernicious anæmia, and their results;—small doses.
Wakefulness of the aged, and that from cerebral anæmia;—small doses.
Impotence, of functional character;—no remedy more efficient.
Progressive Locomotor Ataxia is decidedly ameliorated by Phosphorus.
Skin Diseases; as a substitute for Arsenic in acne, psoriasis and lupus.
Paraplegia, of myelitic origin, from excessive venery.
Osteomalacia and Rachitis are much benefited by Phosphorus.
Threatened Cerebral Softening, in which no other drug seems to affect the nerve centres as beneficially as Phosphorus does.

PHOSPHATES AND PHOSPHITES.

Preparations.

Calcii Phosphas Præcipitatus, Precipitated Phosphate of Calcium, gr. j–x.
Syrúpus Calcii Lactophosphatis, Syrup of the Lactophosphate of C., ʒj.
Sodii Phosphas, ʒj–℥ij. *Sodii Pyrophosphas,* ʒss–ʒj.
Syrúpus Hypophosphitum cum Ferro, Syrup of H. with Iron, ʒj–ʒij.
**Syrúpus Phosphatum Compositus,* Compound Syrup of the Phosphates, Parrish's Chemical Food,—each drachm contains gr. 2½ of Phosphate of Iron, and gr. 1 of Calcium Phosphate.

Physiological Actions. *Phosphate of Calcium* is an essential ingredient of all the tissues, forming more than 50 per cent. of the bones. Lactic and H Cl Acids dissolve it in small quantities. It increases the alkalinity of the blood and its power to hold carbonic acid, and diminishes the excretion of urea. *Phosphate of Sodium* acts similarly on the blood and urea, and increases secretion, especially that of the bile, being an excellent cholagogue, and thereby aiding the digestion of fats. In ounce doses it is laxative.

Therapeutics. *Phosphate of Calcium and the Hypophosphites* are used with advantage in all diseases of mal-nutrition, and where repair or development of the bones is required. They are particularly useful in—

Protracted Suppuration.
Osteo-malacia.
Rachitis.
Caries.
Scrofulosis.
Chronic Phthisis.
Anæmia and Bone Softening of Lactation.

Phosphate of Sodium, in ʒ doses ter die for adults, gr. x–xx for children, is extremely useful in conditions depending on catarrh of the bile ducts and duodenum, as headache, jaundice, chalky stools, etc. Gall-stones may be prevented from forming by scruple or drachm doses of this salt before meals, for months. It is also a good remedy for the following conditions,—

Obesity.
Diabetes.
Incipient Hepatic Sclerosis.
Chronic Infantile Diarrhœa.
Cerebral Debility.
Bilious Sick-headache.
Pasty white stools of ill-conditioned children.

FERRUM,—Iron.

Chief Preparations and their Doses.

Tinctura Ferri Chloridi, Tincture of the Chloride of Iron,—contains about 15 per cent. of the anhydrous salt, with some free HCl. Dose, ♏v–xxx, well diluted.

Mistura Ferri et Ammonii Acetatis, Mixture of Acetate of Iron and Ammonium, Basham's Mixture,—Dose ℥ss–℥j, well diluted.

Massa Ferri Carbonatis, Mass of Carbonate of Iron, Vallet's Mass,—one of the most efficient preparations. Dose, gr. j–v, in pill.

Ferri Sulphas Exsiccatus, Dried Sulphate of Iron,—gr. ss–ij, in pill.

Liquor Ferri Subsulphatis, Solution of Subsulphate (or Persulphate) of Iron, Monsel's Solution. Used only as a styptic.

Syrupus Ferri Iodidi, Syrup of Iodide of Iron,—Dose, ♏v–xl, well diluted and taken through a quill or a glass tube.

Ferrum Reductum, Reduced Iron, Iron by Hydrogen,—Dose, gr. ss–ij.

Ferri Oxidum Hydratum, Hydrated Oxide of Iron, Ferric Hydrate,—a soft magma, only used as an antidote to Arsenic. Prepared by adding 10 parts of Solution of Tersulphate of Iron to 8 parts of Aqua Ammoniæ, and sufficient Water to wash it.

**Ferrum Dialysatum*, Dialysed Iron,—Dose ♏x–ʒj. Is highly praised by many physicians, and unqualifiedly condemned by many others.

**Ferri Albuminas*, Albuminate of Iron,—a cinnamon-brown powder, soluble in water slightly acidulated with HCl. Dose, gr. xx–xl, in simple aqueous solution, or in pill.

Incompatibles, are Acids, Acidulous salts, Alkalies and their Carbonates, Tannic and Gallic Acids and all Vegetable Astringents, hence the Bitters, except Calumba, Quassia, Chiretta, and Gentian, which contain no tannin. The Tincture of the Chloride is decomposed by the Alkalies, Alkaline earths and their Carbonates, Astringent Vegetable infusions, and Mucilage of Acacia.

Physiological Actions. Iron is present in the blood (1 part to 230 of red corpuscles), also in the bile, lymph, gastric juice, etc. Given medicinally, in small doses, it improves the blood, increasing the number of the red corpuscles, and promoting the appetite and digestion. In large doses, nausea and vomiting are produced by the soluble preparations; the Iodide, Chloride, Nitrate and Sulphate being active irritant poisons. Nearly all the preparations are more or less astringent, and act injuriously on the teeth. Only a small portion is absorbed, the rest being eliminated by the intestinal canal, blackenening the fæces by conversion into tannates and sulphides. The Tincture of the Chloride is diuretic.

Therapeutics. The chief indication for Iron is anæmia; when plethora exists it is contra-indicated. It should be given after meals, and occasionally suspended for a time, to avoid deranging the digestion.

Pseudo-Leucocythæmia is much benefited by chalybeates.
Syphilitic Cachexia is greatly influenced by the Iodide of Iron.
Acute Rheumatism, in anæmic subjects only; in them highly useful.
Chorea, of anæmic girls, about the age of puberty,—with purgatives.
Neuralgia, of the anæmic,—large doses of the Tincture of the Chloride.
Cardiac Disorders, fatty heart, weak heart, dilatation, mitral disease.
Nocturnal Incontinence of Urine in delicate children,—the Syrup of the Iodide, ♏ xv–xx ter die, has given excellent results.
Menstrual Disorders, due to anæmia, especially amenorrhœa.
Hemorrhages, of every form,—Monsel's Solution, locally.
Chronic Bright's Disease, the Tinct. Ferri Chlor. as a chalybeate diuretic.
Erysipelas, half-drachm doses of the Tinct. Ferri Chlor. every four hours in very many cases controls the disease; how is not known.
To promote appetite and digestion,—the Sulphate in pill, or the official Pil. Aloes et Ferri, will generally give satisfaction.
Diphtheria,—the Tincture of the Chloride in full doses, has a well-established reputation.

MANGANUM,—Manganese.

Preparations.

Mangani Oxidum Nigrum, Black Oxide, or Binoxide,—Dose, gr. ij–x.
Mangani Sulphas, gr. ij–v. Freely soluble in water, and of bad taste.

Potassii Permanganas, gr. ss.-gr. ij, in distilled water.
**Syrupus Ferri et Mangani Iodidi*, ♏x-xxx. See U. S. Disp., p. 1692.
**Ferri et Mangani Carbonas Saccharatus*, gr. v-xx. Is a tasteless, reddish-brown powder. For its formula see the U. S. Disp., page 1693.

Physiological Actions. The salts of Manganese in small doses improve the appetite and digestion, increase arterial tension, and stimulate the action of the heart. In larger doses they lower the heart's action, paralyze the muscular system, especially the muscular coat of the arteries, causing progressive wasting, paraplegia, and acute fatty degeneration of the liver. They are gastro-intestinal irritants, have specific excitant action on the uterus, and the sulphate is a decided cholagogue. Manganese is closely associated with Iron in the blood, bile, etc., in the proportion of about 1 to 20.

Therapeutics. Manganese is prescribed in—
Anæmia and Chlorosis, in combination with Ferric preparations.
Cachexiæ of various kinds,—the Syrup of the Iodide of Iron and Mang.
Hepatic Disorders, and catarrh of the bile ducts,—the Sulphate.
Chronic Skin Diseases,—the Oxide as an ointment.
Gastrodynia and Pyrosis,—the purified Oxide in doses of gr. x-xv.
Amenorrhœa, and other menstrual derangements,—The Black Oxide, in freshly-made pills of 2 grains each, of which 1-5 pills may be taken thrice daily.

Uses of Permanganate of Potassium. As an antiseptic and oxidizing agent it is used in diphtheria, scarlatina, septicæmia, etc., and is given with benefit in dyspepsia, lithæmia and obesity. Locally it is employed as a deodorizer in cancer, ozæna, otorrhœa, foul breath, and fetid perspiration of the feet, in solution of ʒj to the pint. It is considered a very efficient emmenagogue by many authorities, and is employed in amenorrhœa, and other derangements of the menstrual function. When used internally it must be instantly decomposed in the stomach, and cannot be absorbed in its own form.

BISMUTHUM,—Bismuth.

Preparations.

Bismuthi Subcarbonas, Subcarbonate of Bismuth,—Dose, gr. x-ʒj.
Bismuthi Subnitras, Subnitrate of Bismuth,—Dose, gr. x-ʒj. Both these salts are heavy, white powders, insoluble in water or alcohol, and so nearly insoluble in the gastric juice, that large doses may be safely given if uncontaminated with Arsenic. They are administered in powder, emulsion, troche, or simply stirred up in milk.
Bismuthi et Ammonii Citras, Citrate of Bismuth and Ammonium,—small, shining scales, very soluble in water. Dose, gr. ij-iv.

**Bismuthi Subiodidum*, Subiodide of Bismuth,—a heavy, dark-red, impalpable powder, insoluble, stains fabrics deeply. Not used internally.

Physiological Action of the insoluble salts of Bismuth is chiefly that of a local sedative and astringent,—though a minute quantity passes into the blood, where it acts as a tonic, promoting the constructive metamorphosis by stimulating the appetite and digestion. After a time these salts produce constipation, and always give to the stool and tongue a dark clay color, by reason of their conversion in part to a sulphide in the gastro-intestinal canal. Toxic effects, when occurring, are generally due to the presence of Arsenic, with which most of the commercial preparations are contaminated. Poisonous effects have, however, been observed from their absorption when freely used upon a large wound.

The soluble salts, (Acetate, Citrate, etc.), when given in large doses, have an action like that of Mercury, Antimony or Arsenic;—producing severe gastro-enteritis, fatty degeneration of the liver, etc. The *Subiodide* has an energetic antiseptic and stimulant action upon wounds, ulcers, etc., promoting the growth of granulation tissue, and preventing the formation of pus.

Therapeutics. The Subcarbonate and Subnitrate of Bismuth are given internally in most forms of disordered digestion, vomiting, and diarrhœa, but large doses are necessary to be efficacious. The best vehicle for them is milk. They are well used in—

Acute Gastritis.
Gastralgia, Gastric Ulcer.
Acute Indigestion.
Aphthæ, and Stomatitis.
Vomiting of Children.
Vomiting of Pregnancy.
Gastro-intestinal Disorders of Children.
Diarrhœa of typhoid fever, and phthisis.
Chronic Diarrhœa.

The Citrate, being soluble, is used in solutions with Pepsin, Strychnine, etc., for various affections of the digestive apparatus, in dyspepsia, gastralgia, feeble digestion, etc.

Locally, these salts may be applied with advantage in cases of—

Stomatitis.
Nursing Sore Mouth.
Acne Rosacea.
Eczema.
Intertrigo.
Conjunctivitis.
Gonorrhœa.
Gleet.
Leucorrhœa.

As a dressing for wounds, ulcers, etc., where an antiseptic and stimulating action is desired, there is no application equal to the *Subiodide of Bismuth*, dusted on to the surface after it has been washed and dried.

ARSENIUM,—Arsenic.

Preparations.

Acidum Arseniosum, White Arsenic, Arsenious Acid,—soluble in water, 1 to 33. Dose, gr. $\frac{1}{40}$–$\frac{1}{10}$, after meals.

Liquor Acidi Arseniosi, Solution of Arsenious Acid, Solution of Chloride of Arsenic,—strength $\frac{1}{100}$. Dose ♏ij–x, after meals.

Liquor Potassii Arsenitis, Solution of Potassium Arsenite, Fowler's Solution,—strength $\frac{1}{100}$. Dose, ♏ij–x, after meals.

Liquor Sodii Arseniatis, Solution of Sodium Arseniate, Pearson's Solution,—strength $\frac{1}{100}$. Dose, ♏ij–xv, after meals.

Arsenii Iodidum, Iodide of Arsenic,—soluble in water. Dose, gr. $\frac{1}{30}$–$\frac{1}{10}$.

Liquor Arsenii et Hydrargyri Iodidi, Solution of Iodide of Arsenic and Mercury, Donovan's Solution,—strength $\frac{1}{100}$. Dose, ♏ij–x.

**Liquor Bromi Arsenitis*, Solution of Arsenite of Bromine (or Bromide of Arsenic), Clemen's Solution,—Dose, ♏ij–vj, once or twice daily.

**Cupri Arsenis*, Arsenite of Copper, Paris Green,—not used medicinally, but is often employed as a poison.

Toxicology. Arsenical poisoning is treated as follows:—First, the prompt evacuation of the stomach. Then, administration of the antidote, which is the Hydrated Oxide of Iron, freshly precipitated and in quantity 8 parts for 1 of the poison. Then oil, milk, or mucilaginous drinks, to protect the mucous membrane; and diluents, alkaline mineral waters, Iodide of Potassium, etc., to promote elimination.

Hydrated Oxide of Iron. Ten troy ounces of Solution of Tersulphate of Iron diluted with 100 parts of cold water is added to eight troy ounces of Aqua Ammoniæ previously diluted with 20 parts of cold water, constantly stirred, and the precipitate washed, and added to 20 parts of cold water. *Extemporaneously* the same preparation may be formed by adding Carbonate of Sodium to Tincture of the Chloride of Iron, or Calcined Magnesia to Monsel's Solution.

Chronic Arsenical Poisoning may be avoided by commencing with full doses (♏x of Fowler's solution), then reducing the dose regularly. Unless very small doses are used, Arsenic should always be given just after meals, so as to avoid its irritant action on the gastric mucous membrane.

Physiological Actions.—Arsenic is a very painful escharotic, exciting violent inflammation. Taken internally it is a powerful irritant to the gastro-intestinal and bronchial mucous membranes.

In Small Doses, Arsenic is a stomachic tonic, promoting the appetite and digestion; increases cardiac action, respiratory power, and the secretions of the intestinal tube; stimulates the mind, the sexual appetite, and intestinal peristalsis; causes rotundity of form and a fair skin. When tolerance is established, large doses are taken with impunity, as by the arsenic-eaters of Styria.

In Full Medicinal Doses continued, it produces œdema and itching of the eyelids, increased saliva, nausea, vomiting of mucus, diarrhœa or dysentery, epigastric pain and soreness, irritable and feeble heart, dyspnœa, disordered sensibility, herpes zoster, urticaria, eczema and other skin eruptions, jaundice and albuminuria.

In Toxic Doses, the phenomena may be either gastro-intestinal or profoundly cerebral in character. In the first and most usual form, there is burning pain at the stomach, extending over the abdomen, vomiting, thirst, bloody stools, strangury, suppressed or bloody urine, a rapid and feeble heart, great anxiety, cold breath, albuminuria, collapse. In the nervous form, profound coma, like that of opium narcosis, comes on suddenly, and without any gastro-intestinal symptoms.

Post-mortem shows erosions, ecchymoses, and softening of the gastro-intestinal mucous membrane, congestion of the lungs and the bronchial mucous membrane, fatty degeneration of the internal organs, especially the liver and kidneys.

Therapeutics. Arsenic is very useful in—

Stomach Disorders, as chronic gastric catarrh, irritative dyspepsia, chronic gastric ulcer, cancer of the stomach, gastralgia, and vomiting due to these affections. Very small doses here, gtt. j of Fowler's solution.

Bronchial and Pulmonary Affections, as chronic catarrhs, chronic phthisis, spasmodic asthma, acute coryza, hay fever, etc., are much benefited by smoking arsenical cigarettes.

Diabetes Mellitus,—The Bromide has recently done good service; also Lithiated Arsenical Water as a beverage, made by mixing Lithium Carbonate and Sodium Arseniate in the ordinary carbonated water.

Diarrhœas and Dysentery, chronic and choleraic.

Liver Disorders, of malarial origin, and catarrhal jaundice.

Anæmia and Chlorosis, to promote constructive metamorphosis.

Vomiting of Pregnancy, gtt. j of Fowler's solution before each meal.

Weak Heart, with dyspnœa and œdema of the feet and ankles resulting therefrom,—Arsenic with Iron and Strychnine.

Chorea, large doses, ♏v thrice daily, are very useful.

Malaria is well treated by Arsenic as an adjunct to Quinine.

Epithelioma, and many other forms of cancer, are retarded by it.

Chronic Skin Diseases, particularly psoriasis, and eczema squamosum, and those affecting the superficial strata of the integument.

Rheumatoid Arthritis has been well treated with Arsenic.

Locally, Arsenical paste is used as an escharotic in cancer, but is excessively painful. It is a good depilatory.

BITTERS.

Bitters are divided into the Simple Bitters and the Aromatic Bitters. The latter contain Gallic and Tannic acids, besides aromatic constituents, and are, therefore, more or less astringent. There are also certain special bitters, Eucalyptus, Hydrastis, Cinchona, etc., which will be treated of separately.

SIMPLE BITTERS, their Principles, Preparations and Doses.

Quassia,—The wood of *Picræna excelsa.* Principle, Quassin.
Extractum Quassiæ, gr. j–iij. *Tinctura Quassiæ*, ♏v–ʒj. *Extractum Quassiæ Fluidum*, ʒss–ʒj.

Gentiana, Gentian,—The root of *Gentiana lutea.* Composition, Gentianin, Gentesic Acid.
Extractum Gentianæ, gr. j–v. *Extr. Gentianæ Fluidum*, ʒss–ʒij.
Tinctura Gentianæ Composita, ʒss–ʒij. Contains Cardamom 2, Bitter Orange Peel 4, Gentian 8, Dilute Alcohol to 100 parts.
**Mistura Gentianæ Alkalina*, ʒj–ʒiv. Contains Bicarb. of Sodium, gr. xv, Dil. Hydrocyanic Acid, ♏iij, Infusum Gentianæ Co. ℥j.
**Mistura Gentianæ et Sennæ*, ʒj–ʒvj. Infusum Sennæ ʒiij, and Tinct. Cardamomi ʒj, Infusum Gentianæ Co. ʒvj.

Calumba, Columbo,—The root of *Jateorrhiza Calumba.* Composition, Berberina, Colombin, Columbic Acid.
Extractum Calumbæ Fluidum, ʒss–ʒij, *Tinctura Calumbæ*, ʒss–ʒij.

Cornus, Dog-wood,—The bark of the root of *Cornus florida.* Composition, Cornin, a resin, and Tannic Acid.
Extractum Cornûs Fluidum, ♏x–ʒj.

AROMATIC BITTERS, their Principles and Preparations.

Serpentaria, Virginia Snake-root,—Described under Cardiac Stimulants.

Prunus Virginiana, Wild Cherry,—The bark of *Prunus serotina.* Composition, *Amygdalin* and *Emulsin* (which by their mutual reaction with water produce Hydrocyanic Acid), Tannic and Gallic Acids, etc.
Extractum Pruni Virginianæ Fluidum, ʒss–ʒj
Infusum Pruni Virg., ℥ss–℥ij. *Syrupus Pruni Virg.*, ʒj–ʒij.

Cascarilla,—The bark of *Croton Eluteria.* Composition, Cascarillin, Tannic Acid, etc. **Infusum Cascarillæ*, ℥ss–℥j.

Physiological Actions. The Simple Bitters increase appetite and aid digestion, thus promoting the constructive metamorphosis. They increase the mucous secretion, the flow of saliva and of gastric juice. As they also increase the gastric mucus, their continued use will set up gastric catarrh, and interfere with digestion. *The Aromatic Bitters* have similar properties; and in addition, a local stimulant action upon the alimentary canal, due to the presence of a volatile oil, as well as decided astringent qualities from their Tannic and Gallic Acids. *Cornus* is a good antiperiodic.

Therapeutics. They are used as tonics chiefly in—

Atonic Dyspepsia, with pain after eating,—Quassia or Calumba.

Convalescence,—to promote the appetite and to aid digestion.

Diarrhœa, depending on indigestion, or an irritable intestinal mucous membrane,—Gentian or Calumba.

Flatulence,—an infusion of Calumba, Ginger, āā ℥ ss, and Senna ʒ j.

Malaria,—Cornus, as a tonic and antiperiodic, has considerable repute.

Bronchial Catarrh,—Prunus Virginiana has a domestic reputation.

Hectic Fever, from any source,—Prunus Virginiana is an efficient tonic.

Ascarides Vermiculares,—Quassia internally, and as an enema.

Cough of Phthisis,—Prunus Virginiana in cold infusion.

As Vehicles, the various bitter infusions are much used. The Syrup of Wil Cherry is an ingredient of almost every cough mixture. Quassia, Gentia and Calumba may be prescribed with Iron, as they contain no Tannin.

EUCALYPTUS,—Blue Gum-tree.

Eucalyptus and its Composition. The leaves of *Eucalyptus globulus* or Blue Gum-tree (nat. ord. Myrtaceæ), a native of Australia, now grown in California, Italy, etc. It contains tannic acid, a Volatile Oil, a fatty acid, and a resin which is resolvable into *Turpene*, *Cymol*, *etc.* The oil consists of three oils, which distil over at different temperatures, the first product being called *Eucalyptol.*

Preparations.

Extractum Eucalypti Fluidum,—Dose, ♏x–ʒ j.

Oleum Eucalypti,—Dose, ♏v–xx in emulsion or capsules.

Physiological Actions. It promotes appetite and digestion, stimula the flow of saliva, gastric juice, and the intestinal secretions; increases t heart's action, and lowers the arterial tension. In large doses it causes gre muscular weakness, lowered temperature, nausea and vomiting, indigestio diarrhœa, and if continued will irritate and congest the kidneys. It redu the size of an enlarged spleen, and has anti-malarial properties, absorbi noxious germs, as well as enormous quantities of water from the soil, and by its emanations purifying the atmosphere in its vicinity. It is largely cultivated in malarial districts for these properties, and has rendered habitable a portion of the deadly Roman Campagna. It is destructive to low forms of life.

Eucalyptus is diaphoretic, and a stimulating expectorant. It is eliminated by the skin, bronchial mucous membrane and kidneys, imparting its odor to the breath and urine, being more or less irritant at the points of elimination. [The Oil and its derivatives are described under ANTISEPTIC OILS.]

Therapeutics. Eucalyptus is well administered in—

Chronic Catarrhal Affections of the genito-urinary organs, the broncho-pulmonary mucous membrane, and the bladder, especially the latter.

Bronchitis, acute and chronic,—in the former after the most acute stage.

Asthma,—the leaves smoked in combination with Stramonium, Belladonna, etc.

Chronic Gastric Catarrh, and conditions of the intestinal canal which favor the development of parasites.

Cachexia, and Convalescence,—as a tonic and stimulant.

Stomatitis and Tonsillitis,—a decoction of the leaves, locally.

Ulcers,—as a disinfectant, it destroying low forms of life.

Hysteria, Chorea, etc., in debilitated persons.

Malaria,—as a reconstructant, Eucalyptus is better than Quinine.

Intermittent Fever, in which Eucalyptus has some utility, especially in obstinate cases, where it is desirable to stop the use of Quinine.

HYDRASTIS,—Golden Seal.

Hydrastis is the root of *Hydrastis Canadensis*, (nat. ord. Ranunculaceæ), and contains three alkaloids,—*Hydrastine*, *Berberine* and *Xanthopuccine*, with Tannic and Gallic Acids, etc. Its preparations are—

Extractum Hydrastis Fluidum, ♏v–ʒss. *Tinctura Hydrastis*, ♏x–ʒj.

Physiological Actions.—Hydrastis is an astringent bitter, promotes appetite and digestion, increases the secretions of the gastro-intestinal tract, and the flow of bile. Long used, it deranges digestion and causes constipation. It is an anti-periodic, and a protoplasmic poison, arresting the movements of the white blood corpuscles.

Therapeutics. Hydrastis is chiefly used as a stomachic tonic, an anti-periodic, a mild astringent, and an antiseptic. In—

Catarrh of the stomach, duodenum, gall ducts, intestine, bladder, uterus, vagina;—in gonorrhœa, gleet and chronic nasal catarrh, it is an excellent remedy, both locally and internally.

Syphilitic Affections, of the mouth, throat and nares,—fluid extr. locally.

Ulcers and Sores, of unhealthy character,—locally applied.
Stomatitis, both mercurial and aphthous,—the fluid extract locally.
Constipation, when due to deficient intestinal secretion.
Rectal Fissure and Hemorrhage,—the fluid extract locally.
Intermittents,—here Hydrastine stands next after Quinine.
Malarial Poisoning,—the fluid extract with Iron preparations.

CINCHONA,—Peruvian Bark.

Official Species of Cinchona are three, viz.—

(1). *Cinchona*,—the bark of any species of Cinchona, (nat. ord. Rubiaceæ) containing at least 3 per cent. of its peculiar alkaloids.
(2). *Cinchona Flava*, Yellow or Calisaya bark,—the bark of C. Calisaya.
(3). *Cinchona Rubra*, Red bark,—the bark of Cinchona succirubra.

Another variety, *Cinchona Pallida*, Pale bark, is found in the shops, but is not official, having been dismissed from the last edition of the U. S. Pharmacopœia.

Peculiarities possessed by each variety. They should contain not less than 3 per cent. of the alkaloids and at least 2 per cent. of Quinine. Yellow bark contains most Quinine, Pale bark most Cinchonine, while the Red bark has these alkaloids in about equal proportions. The tree is a native of the western mountains of S. America, and has been planted largely in India, Ceylon and Burmah. The bark from Columbia affords no alkaloids except Quinine.

Composition of Cinchona. It contains 4 chief alkaloids and 17 others also 2 simple acids, 2 tannic acids, a resinoid, and coloring matter, follows,—

ALKALOIDS, 4,—

Quinina, Quinine,—the most valuable.
Quinidina, Quinidine,—the strongest antiperiodic, but it exists in very small quantity.
Cinchonina, Cinchonine,—the least valuable.
Cinchonidina, Cinchonidine,—½ the strength of Quinine.

ACIDS, 4,—

Kinic. *Kino-tannic.*
Kinovic. *Kinovo-tannic*

OTHER CONSTITUENTS—

Kinovin, a resinoid.
Cinchona Red.

Chinoidin, Quinetum, and Quinquinina. *Chinoidin* is the black, residue left after the crystallizable alkaloids have been removed from mother-liquor, and it evaporated. It contains the four alkaloids in amorph condition, and has about one-fourth the strength of Quinine. *Quinetum* (called Quinquinina) is an impure preparation, much used in India. It tains all the alkaloids, the woody fibre being removed, and is about half as strong as Quinine.

Preparations.

Infusum Cinchonæ, Dose, ℥ ss–℥ ij. Cinchona 61, Aromatic Sulphuric Acid 1, Water 93. Is the only official infusion containing Sulphuric Acid.

Tinctura Cinchonæ, strength 20 per cent. Dose, ʒ ss–ʒ ij.

Tinctura Cinchonæ Composita, a substitute for Huxham's Tincture of Bark, strength 10 per cent., ʒ j–℥ ss. Contains Cinchona Rubra 10, Serpentaria 2, Orange Peel 8, Glycerin 10, Alcohol, Water, āā q. s. ad. 100.

Quininæ Sulphas, Sulphate of Quinine. Dose, gr. j–xx, even xl. Soluble in 740 parts of cold water, and in smaller proportions of acidulated water.

Cinchonidinæ Sulphas, Sulphate of Cinchonidine. Dose, gr. ij–xxx. It is being much used, especially in hospital and dispensary work.

Incompatibles. Free Tannic Acid is incompatible with the infusion. Iodine, Alkalies, Alkaline carbonates and earths are incompatible with the alkaloids, the first named forming insoluble compounds therewith, and the latter precipitating them from solution.

Antagonists. As to its cerebral action *Morphine* is antagonistic; *Belladonna* or *Atropine* to its nervous, cardiac, and antipyretic powers.

Physiological Actions. Cinchona is an astringent bitter tonic, an antiseptic, antiperiodic, antiphlogistic, antipyretic and antimiasmatic, a diminisher of reflex action, a protoplasmic poison, and a direct emmenagogue and an oxytocic. Its alkaloids are rapidly diffused and slowly excreted, being found in the urine in ¼ of an hour after administration, and for three days afterwards. At first it promotes appetite, digestion, the flow of saliva and of gastric juice; but long continued it sets up a gastric catarrh, impedes digestion and causes constipation. It arrests the movements of the white blood corpuscles, though increasing their number; and prevents acetification and decay of the blood. *The Heart* and arterial tension are somewhat stimulated by small doses, but depressed by large ones (gr. xl–lxx), which slow and enfeeble the pulse, the drug acting directly on the cardiac ganglia. *The Brain* is exhilarated by small doses, large ones causing anæmia, pallor, a sense of fullness and constriction in the head, singing in the ears, vertigo, a staggering gait, amaurosis and deafness (though the eyes and ears are rarely ever injured seriously), great headache, coma, dilated pupils, delirium, and in animals convulsions. These symptoms collectively are termed "Cinchonism." *The Reflex Function* of the cord is lowered very markedly by large doses. *The Spleen* is reduced in size, and the temperature of pyrexia lowered, though it does not depress the body temperature in health. In some subjects it causes sexual excitement, in others cutaneous eruptions followed by desquamation; it lessens the excretion of uric acid, but not that of urea; and is a uterine stimulant in labor. Its power to initiate uterine contractions is still a much debated question.

Therapeutics. The principal use of Cinchona is in the malarial diseases, over which its influence is that of a specific. In—

Intermittents,—gr. x of Quininæ Sulphas in the sweating stage and again five hours before the expected time of the next paroxysm. *Arsenic* in the intervals, in lieu of Quinine, which will cause a daily exacerbation of temperature if long continued.

Remittent Fever,—gr. xx–xxx once or twice a day, until the temperature is reduced to the normal point.

Pernicious Fever,—large doses, gr. xxx–lx, are necessary to safety.

Chronic Malarial Poisoning,—Chinoidin is more effective than Quinine.

Prophylactic, against malaria,—Quinine, gr. ij–iij per diem, is effective.

Inflammations, at their inception, may be aborted by Quinine, gr. xv–xx combined with Morphine, which here is synergistic to it.

Acute Tonsillitis, may sometimes be aborted by Quinine in full dose.

Acute Catarrh may often be aborted by Quinine, gr. x, Morphine, gr. ¼.

Surgical Fever, and before surgical operations, Quinine is much used.

Septicæmic Fevers, and Hectic, are well treated with Quinine and Alcohol.

Neuralgias, of the ophthalmic division of the 5th, and when due to malaria.

Skin Diseases, especially erythema nodosum, and erysipelas.

Eruptive Fevers, especially scarlet fever and measles, throughout course.

Hay-asthma, a solution of the neutral chloride, applied locally, gr. vj ad ℥j.

As a Tonic, the Infusion or Compound Tincture is best with a mineral acid; has many applications, as in atonic dyspepsia, gastric catarrh of drunkards, adynamic states, convalescence, asthma, chronic bronchitis, insanity, and generally in weak subjects of flabby flesh and perspiring skin.

AGENTS PROMOTING WASTE.

POTASSIUM.

Preparations.

Potassa, Caustic Potash, Hydrated Protoxide of Potassium. A painful escharotic, acting deeply; soluble in 0.5 of water.

Liquor Potassæ, Solution of Potassa. Dose, ♏ij–xv, well diluted with water.

Potassii Acetas. Dose, gr. x–ʒj.

Potassii Carbonas. Dose, gr. ij–x.

Potassii Nitras, Nitre. Dose, gr. ij–x.

Potassii Citras. Dose, gr. v–ʒss.

Potassii Chloras. Dose, gr. v–[illegible]

Potassii Bichromas. Dose, gr. [illegible]

Potassii Bitartras, Cream of Tartar. Dose gr. v–ʒj. Sol. in 210 of water.
Potassii et Sodii Tartras, Rochelle Salt, gr. x–ʒss. Sol. in 2½ of water.

[The Bromide is treated of under BROMIDES; the Permanganate under MANGANESE, page 55.]

Physiological Actions. Caustic Potash, like the other caustic alkalies, destroys the tissues by combining with their water, dissolving the albumen and saponifying the fats. The Potassium Salts increase the saliva, promote oxidation and the retrograde metamorphosis. In small doses on an empty stomach they promote the formation of acid gastric juice, by favoring the outward osmosis of its constituents from the blood; in large doses they act chemically in the stomach, neutralizing its free acids, and disordering digestion. *The Bicarbonate*, given on an empty stomach, enters the blood unchanged, meets the neutral phosphate of sodium, forming the acid phosphate, and making the urine more acid. On a full stomach it is decomposed before entering the blood, and makes the urine less acid. *The Vegetable Acid Salts* (acetate, citrate, etc.) enter the blood in their own form, are there decomposed, forming CO_2, and alkaline carbonates, in which form they are excreted, alkalinizing the blood and urine. They are also diuretics, increasing both the water and the solids of the urine, but decreasing the uric acid by increasing oxidation. *The Mineral Salts* (nitrate, chlorate, etc.) are not decomposed in the blood, but are eliminated in their own form; the Nitrate being a most active diuretic, the Chlorate irritating the kidneys, and causing albuminuria. In large doses these salts decompose the red corpuscles of the blood, and paralyze the motor ganglia of the heart. *All Potassium Salts*, in large doses, are cardiac poisons, muscular paralyzers, poisonous to protoplasm, especially to nerve tissues, and destructive to the ozonizing function of the blood. This is especially true of the Bromide.

Poisoning by Caustic Alkalies is treated by the Vegetable Acids, as vinegar, lemon-juice; then Demulcents and Oils to protect the mucous membrane, and sustaining measures to support the vital powers.

Therapeutics. As Alkalies the Potassium salts are used in—

Acute Rheumatism,—the Bicarbonate and Nitrate, to saturate the blood, and make the urine alkaline; is effective treatment for sthenic patients.

Lithæmia,—the Acetate or Citrate, to promote oxidation. If the Bicarb. is given, it should be during digestion, to render the urine less acid.

Acidity and *Atonic Dyspepsia*—the Bicarbonate, or Liquor Potassæ with a bitter, in small doses before meals. If given after meals larger doses are required for temporary alleviation by neutralizing the food acids.

Mouth Affections, as ulcerative stomatitis, aphthæ, nursing sore mouth, follicular pharyngitis,—the Chlorate locally, as detergent wash. This salt must be cautiously used internally, as it is a dangerous irritant to the kidneys.

Inflammations,—Acetate, to promote the excretion of resulting products.

Cardiac Dropsy, if general,—the Bitartrate in Infusion of Juniper.

Acute Desquamative Nephritis,—the Bitartrate, but not in Juniper infusion.

Diphtheria,—the Chlorate both locally and internally, with the Tincture of the Chloride of Iron, has a high reputation. It should never be prescribed in a mixture with glycerin, lest an explosion result.

Skin Affections, as acne, eczema, prurigo, etc., alkaline solutions, locally.

Catarrhs, nasal, buccal, or vaginal,—the Bichromate (gr. j–x ad ℥iv aquæ), locally;—or the Chlorate as a detergent wash.

SODIUM.

Preparations.

Soda, Sodium Hydrate, Caustic Soda,—sol. in 1.7 of water.

Liquor Sodæ, Solution of Soda,—Dose ♏ij–x, well diluted with water.

Sodii Bicarbonas,—Dose gr. v–ʒj. *Sodii Boras*, Borax,—Dose, gr. ij–xx.

Sodii Sulpho-carbolas,—Dose gr. j–x. Described under Carbolic Acid.

Pulvis Effervescens Compositus, Seidlitz Powder. Sodii Bicarb., gr. xl; Potassii et Sodii Bitartras, gr. cxx; Acidum Tartaricum, gr. xxv.

[The Phosphate is treated of under Phosphates,—the Bromide under Bromum,—the Arseniate under Arsenic, etc., etc.]

Physiological Actions are similar to those of Potassium, except that the Sodium salts are feebler alkalies, are not so depressant, and are not such powerful cardiac and nerve poisons. The Chloride exists normally in the blood, where it keeps the fibrin and albumen in solution; and in inflammation, being greatly needed therefor, it accumulates at the seat of the morbid action, disappearing for the time from the urine. Its reappearance therein is a sign of improvement. [This salt is fully described under Chlorum.]

Therapeutics. Internally the Sodium salts are not much used, the Potassium and Lithium salts being preferred. Locally in—

Burns, a saturated solution of the Bicarbonate is an agreeable application.

Skin Diseases, as eczema, acne, prurigo, pityriasis, fetid sweats.

Freckles may be removed by using a saturated solution of Borax in rose-water, as a face-wash night and morning.

Intussusception may be treated by effervescing powders, the soda being fi injected, then the acid. Danger, rupture of the bowel.

Narcotic Poisoning,—the same method, as an emetic, per orem.

Seidlitz Powders are used as refrigerants and gentle laxatives.

In Lithæmia, Acid Urine, and *Acidity of the Stomach*, the Sodium s should not be used; Potassium or Lithium salts being far superior in th conditions.

LITHIUM.

Preparations.

Lithii Citras, Citrate of Lithium,—Dose gr. v–x. Extemporaneously prepared by adding Citric Acid to a solution of the Carbonate in water.

Lithii Carbonas,—Dose, gr. ij–x. *Lithii Bromidum*,—Dose, gr. v–xx.

Physiological Actions. It acts purely as an alkali, being the most decided alkali of the group.

Therapeutics are but few. In the—

Indigestion and Rheumatism of the obese, the Lithium salts are useful.

Lithæmia is best treated by the Citrate or Bromide of Lithium.

Chronic Rheumatic Arthritis,—the Bromide, both internally and locally.

Myalgia,—the Bromide of Lithium is very useful, in 5-grain doses.

Diabetes Mellitus,—Lithiated Arsenical Water, as a beverage; see *ante*, under ARSENIC.

CALCIUM.

Preparations.

Liquor Calcis, Lime-water, ℥ss–ij.

Syrupus Calcis,—Dose ʒss–ij.

Calcii Carbonas Præcipitatus,—Dose gr. v–xx.

Mistura Cretæ, Chalk-mixture,—Dose ʒj–℥ss.

Creta Præparata, Prepared Chalk,—Dose, gr. v–xx.

* *Testa Præparata*, Oyster-shell,—Dose gr. v–xx.

[The Phosphate is treated of under the title PHOSPHATES, *Calx Sulphurata* under SULPHUR, and *Calx Chlorata* under CHLORUM.]

Physiological Actions. Feebly alkaline, the preparations of Calcium are mere astringent antacids. The actions of the Phosphate have already been described. *Syrupus Calcis* is the antidote to Carbolic Acid, or Oxalic Acid poisoning.

Therapeutics. *Lime-water* is used in the summer vomiting of children, and is added to their milk when the latter is not well retained. *Chalk mixture* is prescribed in the diarrhœa of children, with sour-smelling watery stools. In *Diphtheria* and *Croup*, the vapors of slaking lime, or lime-water spray, are often very serviceable.

AMMONIUM.

Aqua Ammoniæ, Water of Ammonia,—an aqueous solution of the gas, of $\frac{1}{10}$ strength by weight. Dose, ♏v–xxx, well diluted.

Ammonii Carbonas, Carbonate of Ammonium,—Dose, gr. ij–x.

Ammonii Chloridum, Sal Ammoniac, gr. j–xx.

Linimentum Ammoniæ, Aqua Ammon. 30, Cotton-seed Oil, 70.

Liquor Ammonii Acetatis, Spirit of Mindererus, ʒj–℥j. Prepared by dissolving the Carbonate in dilute Acetic Acid.

Spiritus Ammonii Aromaticus, ♏x–ʒij. The Carbonate with Aromatics.

**Raspail's Eau Sédatif.*—Aqua Ammoniæ, ℥ij, Sodii Chloridum, ℥ij, Camphorated Spt. of Wine, ʒiij, Aqua ℥xxxij. For local use.

[The Bromide is treated of under the heading BROMIDES, the Iodide under IODUM, and the Benzoate under BENZOIN.]

Physiological Actions. *Ammoniacal Gas* is intensely alkaline, and irritant to mucous membranes; inhaled, it causes spasmodic cough and a sense of suffocation, prolonged inhalation inducing violent inflammation and œdema of the glottis. It exists normally in the blood, to maintain its fluidity by helping to keep its fibrin in solution. *The Aqua*, swallowed, sets up violent inflammation of the passages and the stomach, and may cause stenosis of the pylorus or œsophagus. *Its salts*, in medicinal doses, act as stimulant expectorants, diffuse rapidly, and stimulate the heart's action; continued, they produce rapid emaciation, from the impaired digestion and increased tissue-waste set up. In large quantity, they injure the structure of the red blood-corpuscles. *The Chloride* has decided cholagogue powers, promotes the excretion of urea, and is purgative in 30-grain doses. The *Phosphate* and *Benzoate* are diuretic, and the latter acidifies a phosphatic urine.

Antagonists. When inhaled, give HCl vapors, by inhalation, to form the Chloride; if in solution, give Vegetable Acids, and demulcents to protect the mucous surfaces. Therapeutically, its antagonists are the cardiac sedatives, Aconite, Digitalis, Veratrum, etc.

Therapeutics. As a stimulant expectorant in—

Chronic Bronchitis, and Bronchorrhœa, the Chloride is of great service.

Pneumonia, at the crisis, the Carbonate, in infusion of Senega,—liquefies the products of inflammation, and counteracts the adynamia.

Neuralgias, as ovarian and migraine, also in nervous headache,—the Chloride in 30-grain dose, with gtt. ij–v Tinct. Aconiti, to relieve pain;—or Raspail's Eau Sédatif applied locally.

Exanthemata, especially variola, scarlatina and erysipelas, when feeble circulation, cyanosis and delirium,—the Carbonate in a solution of the Acetate or the Liquor Ammonii Acetatis.

Catarrhs, gastric, duodenal and intestinal,—the Chloride has a high reputation —also in bronchial catarrh, when secretion is scanty and tough, and in chronic bronchitis.

Hepatic Disorders, as incipient cirrhosis, chronic torpor, catarrh of the bile ducts and its jaundice, bilious conditions, etc,—the Chloride with fluid extract of Taraxacum, gives great relief.

Acidity and Vomiting,—the Carbonate in a solution of the Acetate.

Hysteria,—the Valerianate and the Aromatic Spirit are much employed.

Fevers,—the Carbonate is used as a stimulant, and the Acetate as a febrifuge.

Poisoned Bites and Stings are treated locally with Aqua Ammoniæ.

Inflammations,—the Chloride in Alcohol and Water, as a lotion.

As a Cardiac Stimulant in syncope, thrombosis, hemorrhage, chloroform narcosis, snake-bites and hydrocyanic acid poisoning,—the Spirit or the Carbonate inhaled or the diluted Aqua intravenously;—acts by relaxing the cardiac inhibition.

Cystitis, with alkaline urine and phosphatic deposits,—the Benzoate is very useful, acidifying the urine, and stimulating and disinfecting the vesical mucous membrane.

ANTIMONIUM,—Antimony.

Preparations.

Antimonii et Potassii Tartras, Tartar Emetic. Dose, gr. $\frac{1}{16}$–$\frac{1}{4}$; after tolerance as high as gr. ij may be given to an adult.

Vinum Antimonii, ♏v–ʒij; has 2 grains of Tartar Emetic to the ℥.

Syrupus Scillæ Compositus, Compound Syrup of Squill, Cox's Hive Mixture, —Dose, ♏v–ʒj;—contains about ¾ grain of Tartar Emetic to the ℥, with Squill, Senega, Calcium Phosphate, Diluted Alcohol, Sugar, and Water.

Pulvis Antimonialis, Antimonial Powder, James' Powder. Dose, gr. iij–viij. Is one-third Oxide of Antimony, with two-thirds Calcium Phosphate.

Treatment of Poisoning by Tartar Emetic. Administer Tannic Acid, in some form, as an antidote; then Opium as an antagonist, and demulcent drinks to protect the mucous membrane.

Physiological Actions of Tartar Emetic. It is a systemic and local emetic, a diaphoretic, an arterial sedative, and a gastro-intestinal irritant; has a styptic taste, and causes constriction of the fauces. As an emetic, it is too depressant for use. It promotes waste and the rapid excretion of waste products.

In Small Doses, it stimulates the secretions of the stomach and intestinal canal, the salivary glands, liver and pancreas. *In Larger Doses*, it produces vomiting and purging, with evacuations much like the "rice-water discharges" of cholera, and great prostration of the vital powers. *Toxic Doses* produce similar symptoms, with epigastric pain, cyanosis, delirium, motor and sensory paralysis, suppression of urine, collapse,—much the phenomena of Asiatic Cholera. It is paralyzant to the heart-muscle, combines with the red blood corpuscles, depressing their oxidizing power, lowering the blood pressure, and reducing the temperature. Being eliminated by all the excretory organs, including the skin, it excites follicular inflammation therein, resulting in a papular eruption on the integument, which becomes vesicular and pustular, the pustules being umbilicated, like those of variola. This may be produced by rubbing it into the skin.

Therapeutics. The use of Tartar Emetic was formerly greatly abused, and it has now gone out of fashion. It is, however, useful in—

Acute Cold and Bronchitis,—gr. $\frac{1}{16}$ with gr. $\frac{1}{16}$ of Morphine, is excellent.

Asthma and Emphysema, with lack of secretion, are much relieved by gr. $\frac{1}{16}$, to relax spasm and promote secretion.

As a Hypnotic in the active delirium and restlessness of fevers, especially typhoid,—Tartar Emetic gr. $\frac{1}{8}$, with gr. $\frac{1}{8}$ of Morphine, is serviceable.

Wheezing of young children, with dyspnœa and cough, simulating asthma, may be stopped by gr. j of Tartar Emetic in O$\frac{1}{2}$ Water, of which teaspoonful doses hourly.

VEGETABLE ACIDS.

Vegetable Acids used in Medicine, and their doses.

Acidum Aceticum Dilutum. Dilute Acetic Acid. Dose, ʒj–ij.

**Acetum,* Vinegar,—an impure dilute acetic acid, formerly official.

Acidum Citricum, used as **Succus Limonis,* Lemon-juice. Dose, ℥ss–ij.

Acidum Tartaricum, gr. x–xx. 100 grains saturate 133$\frac{1}{2}$ grs. of Potassium Bicarbonate. *Pulvis Effervescens Comp.,* see under SODIUM.

Physiological Action. In concentrated form they have escharotic powers and produce gastro-enteritis if swallowed. In dilute form they diminish thirst and allay restlessness. They form salts in the stomach, thus enter blood, and are there oxidized, producing carbonic acid, which increases acidity of the urine. They promote secretion, and increase the water of urine. Long continued they cause emaciation and poverty of the blood, fact a general scorbutic condition. Tartaric Acid has been fatal in a dose ℥j. Acetic has caused death once. Citric seems to be non-toxic in man.

Therapeutics. Tartaric Acid is rarely used except in the efferve powders, Citric being preferred. The latter is used in—

Scurvy, as a prophylactic and a curative agent, in form of Lemon-juice.

Acute Rheumatism,—Lemon-juice freely, ℥j–ij used 4 or 5 times a day.

Fevers,—Lemonade to be used freely, as a refreshing and refrigerant drin

Inflammations,—Dilute Acetic in superficial inflammations of the skin.

Skin Affections, as warts, vegetations, pityriasis, etc.,—Glacial Acetic A used as a caustic.

Obesity,—Lemon-juice to correct fatness, acts by impairing digestion.

Atheromatous Degeneration may be retarded by the daily use of Lemon-juice, which dissolves the excess of inorganic matter, and permits of its elimination from the body.

SULPHUR, SULPHITES, SULPHIDES.

Preparations.

Sulphur Lotum, Washed Sulphur. Dose, ʒj–iij, in syrup, as a laxative.

Acidum Sulphurosum, Sulphurous Acid. Dose, ♏v–ʒj. A colorless liquid containing about 3.5 per cent. of Sulphurous Acid Gas, and about 96.5 per cent. of Water.

Sodii Sulphis, Sulphite of Sodium, gr. v–xx. *Sodii Hyposulphis*, gr. v–xx.

Potassii Sulphis, gr. iij–x. **Potassii Sulphidum*, Sulphide of P. gr. j–v.

Calx Sulphurata, Sulphurated Lime, commonly misnamed Sulphide of Calcium. Dose, gr. $\frac{1}{10}$–ij. A grayish white powder, of foul odor, and very insoluble. Is best administered in trituration.

**Ichthyol*,—is a preparation obtained from a bitumen found in the Tyrol, and regarded as the residue of extinct fishes. It contains Sulphur in the proportion of about 10 per cent., is soluble in a mixture of Ether and Alcohol, mixes with vaseline, oils and lard, and is non-irritant to the skin. For local use, in a 10 to 20 per cent. ointment.

Physiological Actions. *Sulphur* is a very mild laxative. It is dissolved by alkaline solutions and oils, hence is absorbed from the small intestine, entering the blood, and discoloring silver coins carried by those using it, by forming a sulphide of silver. *Sulphurous Acid* has great affinity for oxygen, and is a powerful disinfectant and deodorizer, and destructive to all low life. Its gas inhaled is irritant to the glottis, causing inflammation of the passages. *The Sulphites and Hyposulphites* are partly decomposed by the acid of the stomach, sulphurous acid being given off, and the balance converted into sulphates and absorbed, undergoing elimination as sulphates by the kidneys. *The Sulphides* also are partly converted into sulphates. They are irritant to the stomach, etc., extremely nauseous in taste and smell, increase the secretion of the intestinal glands, and are laxative. If administered for some time they impair the blood, and cause emaciation, anæmia, trembling and great debility. *Ichthyol*, in one case, where a 20 per cent. ointment was applied to an eczema infantile, produced a stupor which continued 12 hours, but from which the child made a complete recovery.

Therapeutics. *Sulphur* is used as a laxative when the stools need softening on account of hemorrhoids and fissure, etc. In—

Chronic Rheumatism and Sciatica—Sulphur has some repute.

Scabies,—Sulphur locally as a parasiticide; or a solution of the Sulphide of Potassium in water, ʒss ad ℥j, as a bath or wash.

Chronic Bronchitis, with bronchorrhœa.—Sulphurous acid as spray.

Acidity, Pyrosis, and Acid Indigestion, Sulphurous acid, ♏v, diluted.

Chilblains,—Sulphurous acid with Glycerin, is a good application.

Gangrenous Wounds,—Sulphurous acid the best antiseptic application.

Constipation,—the Blue Lick Water, Oj before breakfast; or the Sulphides.

Lead Poisoning,—Sulphur baths to favor the elimination of the metal.

Suppuration may be prevented or at least limited, by the Sulphide of Calcium internally, in small doses, gr. $\frac{1}{10}$, hourly. In crops of boils, scrofulous sores, glandular enlargements, acne, and even in extensive suppuration, this remedy proves very efficient.

Skin Diseases,—Sulphur baths are very useful, especially in pityriasis, prurigo, chronic psoriasis and eczema. In the two last-named diseases Unna employs Ichthyol in ointment with excellent results.

ALTERATIVES.

IODINE, IODIDES.

Iodum, Iodine,—is a non-metallic element, existing in sea-water and sea-plants chiefly, and occurs in bluish-black plates, of rhombic shape, metallic lustre, peculiar odor, acrid taste and neutral reaction. It is sparingly soluble in water, (1 in 7000), readily so in ether and in alcohol (1 in 12), also in a solution of potassium iodide or sodium chloride. Dose, gr. ss–j, but it is never administered in crude form.

Preparations.

Amylum Iodatum, Iodized Starch,—5 per cent. Dose, ʒj–℥j.

Liquor Iodi Compositus, Compound Solution of Iodine, Lugol's Solution,—has Iodine 5, Potassium Iodide 10, Water 85. Dose, ♏j–x, diluted.

Tinctura Iodi, Tincture of Iodine,—8 per cent. Dose, ♏j–v.

Unguentum Iodi, Iodine Ointment,—I 4, Pot. Iod. 1, Aq. 2, Adeps 93.

Ammonii Iodidi, Iodide of Ammonium,—Dose, gr. v–xx.

Potassii Iodidi,—Dose, gr. v–ʒj. *Unguentum Potassii Iodidi*, 12 per cent.

Sodii Iodidi,—Dose, gr. x–ʒij. *Arsenii Iodidi*,—Dose, gr. $\frac{1}{30}$–$\frac{1}{10}$.

Syrupus Acidi Hydriodici, Syrup of Hydriodic Acid,—1 per cent., ʒj–ʒiv.

Iodoformum, Iodoform, Iodide of Formyl,—lemon-yellow crystals, of vile and persistent odor. Dose, gr. j–v. To remove the odor, mix it with Thymol, gtt. ij ad ℥, or Balsam Peru, or Oil of Mirbane (Nitro-Benzol), gtt. xx ad ʒ, or Oil of Bitter Almonds, or Oil (Attar) of Rose.

Unguentum Iodoformi, Iodoform Ointment,—10 per cent. strength.

**Suppositoria Iodoformi*, Iodoform Suppositories, (B. P.),—each contains 3 grains.

**Iodol*,—a grayish-yellow powder, insoluble in water, tasteless and odorless, and contains 85 to 90 per cent. of Iodine in combination with *Pyrol*, a constituent of mineral oil. Dose, gr. ss–v, in tablet.

**Iodo-tannin*,—is Tannic Acid in Tincture of Iodine. For local use.

**Iodized Phenol*, Carbolate of Iodine,—a mixture of Iodine and Carbolic Acid in various proportions, for local use.

**Bismuthi Subiodidum*,—Subiodide of Bismuth,—a heavy, dark-red, impalpable powder, only used locally, as a dressing for wounds, sores, etc. See *ante*, page 56, under BISMUTH.

[The Iodides of Arsenic, Silver, Mercury, Iron, Lead, Sulphur and Zinc, are classed with their other bases, being allied more closely with them, in their actions and uses, than with Iodine.]

Physiological Actions. *Iodine* is irritant, also vesicant if used in quantity, staining the skin yellow. Combining with the hydrogen of phosphuretted and sulphuretted gases it is a disinfectant and deodorant. *The Iodides* are very diffusible and rapidly excreted; setting free ozone and iodine at the points of elimination, they are irritant, setting up violent coryza, with soreness of the throat and eyes, headache and profuse mucous discharge, with irritation of the kidneys. They induce great waste and rapid elimination of waste products, causing anæmia, emaciation, and depression, if used for any length of time. They combine with foreign substances in the system and remove them. *Iodism* comprises the foregoing symptoms, together with frontal headache, a saline taste in the mouth, dysphagia, an acne-form eruption on the face and limbs, and temporary impotence. Sometimes the eruption is furuncular, or even purpuric. Copious dilution of these salts with water promotes their excretion, and to a great extent prevents these results from following upon their continued administration, as is sometimes necessary in the treatment of disease.

Iodoform contains from 94 to 97 per cent. of Iodine. It is a local anæsthetic, and (clinically) an efficient antiseptic, inhibiting, if not destroying, the microbes of putrefaction and pus formation. If applied too freely to an extensive raw surface it may be absorbed in dangerous quantity, and produce symptoms of narcotic poisoning, with increased temperature, quick and feeble pulse, collapse and death. In small doses internally it is considered tonic and alterative, and to possess sufficient power against certain pathogenetic microbes to cause their disappearance from the morbid products accompanying the disease.

Iodol has the same action as Iodoform, but is odorless and is said to be devoid of toxic power. Though insoluble in water it dissolves readily in the gastric juices, and is rapidly absorbed and as quickly diffused through the system.

Toxicology. The antidote to free Iodine is *Starch,* with the object of forming an Iodized Starch, which should then be evacuated from the stomach. In chronic poisoning by the Iodides, a free salivary flow, excited by chewing Pyrethrum-root, will hasten the elimination of the drug.

Therapeutics of Iodine. The Tincture is much used as a counter-irritant, and an alterative injection. Iodo-tannin is chiefly employed as an antiseptic and alterative application in local diseases. The preparations of Iodine are used with benefit in—

Catarrh and Hay Fever,—inhalations of Iodine or the Carbolate.

Inflammations,— Tincture of Iodine locally, to promote absorption.

Skin Diseases,—the Glycerite or Tincture, in chloasma, lentigo, lupus.

Chronic Diseases of the Spleen and Liver,—the Tincture or Ointment may be used locally for counter-irritation.

Glandular Tumors, hypertrophied tonsils, cervical cysts, etc.,—the Tincture or Compound Solution parenchymatously injected, is an efficient resolvent procedure.

Empyema, Hydrocele, Ovarian Cysts, etc,—the Tincture injected undiluted, is one of the best applications, to prevent return of the effusion.

Sores, Ulcers, Fissures, etc.,—Iodoform, Iodo-tannin, or Iodized Starch, are highly recommended, as local antiseptics and alteratives.

Vomiting of Pregnancy,—drop-doses of the tincture every hour; have often succeeded in very obstinate cases.

Therapeutics of the Iodides. They are especially used in—

Acute Catarrh and Hay Fever,—Potassium Iodide with Arsenic internally; also Iodine and Carbolic Acid in weak solution locally.

Chronic and Capillary Bronchitis,—the Ammonium Iodide, in small doses rapidly administered, is remarkably efficacious.

Catarrhal Pneumonia,—the Ammonium Iodide, to prevent caseation of the products. Arsenic may well be combined with it.

Spasmodic Asthma,—Potassium Iodide, in 15 to 30-gr. doses, is often very efficient, especially when due to bronchial catarrh.

Hepatic Cirrhosis, in the first stage—Ammonium Iodide with Arsenic.

Duodenal Catarrh, and jaundice therefrom,—Ammonium Iodide.

Aneurisms,—Potass. Iod. in large doses (gr. xv–xxx) is often curative of internal aneurisms, when conjoined with absolute rest.

Tertiary Syphilis, and many of its results, as neuralgiæ, paralyses from gummata, syphilitic ulcerations, syphiloma of the internal viscera, chronic rheumatism and sciatica of syphilitic origin, lupus of syphilitic or scrofulous origin,—are all best treated by Iodide of Potassium.

Mercurial Poisoning, and other chronic metallic toxæmiæ,—the Iodide of Potassium, to promote elimination.

Malaria,—the Ammon. Iod. with Arsenic, in chronic malarial poisoning.

Tonsillitis, and simple sore throat,—a weak solution of Potass. Iodide.

Chronic Bright's Disease,—the prolonged use of Potassium Iodide has seemed to retard the progress of the parenchymatous changes.

Therapeutics of Iodoform and Iodol. As local applications these agents have been extensively used in the treatment of epithelioma, chancre and chancroid, wounds, ulcers, sores, etc., and but for its offensive odor and the danger of its toxic action Iodoform would have been in unrestricted employment for all such conditions. Iodol, if equally efficient, as is claimed, will doubtless replace it largely as a topical application. Internally they are both highly esteemed as remedies in—

Chronic Gastric Catarrh, and intestinal catarrh, ulceration of the gastro-intestinal mucous membrane, etc.,—Iodol given midway between meals.

Bronchitis, Bronchial Catarrh, and various respiratory neuroses,—Iodol has been found highly useful.

Tuberculosis—is successfully treated by Iodoform, which certainly does check the activity of the bacillus of that disease.

Diabetes,—has been apparently cured by Iodoform.

Syphilis,—will be combated successfully by Iodoform or Iodol, in lieu of the Iodide of Potassium.

Hydriodic Acid is used as a substitute for Iodine and the Iodides, being less offensive to the taste and stomach. It is official only as the Syrup, the Acid itself not being a stable preparation.

HYDRARGYRUM,—Mercury.

Preparations.

Hydrargyrum cum Creta, Mercury with Chalk, Gray Powder. Dose, gr. ss–x.

Massa Hydrargyri, Blue-pill. Dose, gr. ss–xv. Each grain contains gr. $\frac{1}{3}$ of Mercury, with Liquorice, Althæa, Glycerin and Honey of Rose.

Unguentum Hydrargyri, Blue Ointment,—Mercury, Lard, Suet, Benzoin.

Hydrargyri Chloridum Corrosivum, Bichloride, Mercuric Chloride, Corrosive Sublimate. Dose, gr. $\frac{1}{30}$–$\frac{1}{16}$. Soluble in 16 parts of water.

Hydrargyri Chloridum Mite, Mild Chloride, Subchloride, Mercurous Chloride, Calomel. Dose, gr. $\frac{1}{16}$–gr. x. Insoluble in water or alcohol.

Hydrargyri Subsulphas Flavus, Yellow Subsulphate, Turpeth Mineral. Dose, gr. ij–vj, as an emetic. Insoluble in water or alcohol.

Hydrargyri Oxidum Flavum, Yellow Oxide. Dose, gr. $\frac{1}{50}$–$\frac{1}{10}$. *Unguentum Hydrargyri Oxidi Flavi* has strength of $\frac{1}{10}$. *Oleatum Hydrargyri*, Oleate of Mercury,—Yellow Oxide of Mercury 1, in Oleic Acid 9.

Hydrargyri Oxidum Rubrum, Red Precipitate. *Unguentum Hydrargyri Oxidi Rubri*, has strength of 10 per cent.

Hydrargyri Iodidum Viride, Green Iodide, Protiodide. Dose, gr. $\frac{1}{10}$–$\frac{1}{3}$.

Hydrargyri Iodidum Rubri, Red Iodide, Biniodide. Dose, gr. $\frac{1}{30}$–$\frac{1}{10}$.

Hydrargyri Cyanidum, Cyanide of Mercury. Dose, gr. $\frac{1}{100}$–$\frac{1}{10}$.

Unguentum Hydrargyri Nitratis, Citrine Ointment. Mercury 7, Nitric Acid 17, Lard Oil 76. **Unguentum Hydrargyri Nitratis Rubrum*, Brown Citrine Ointment. Made with Ol. Morrhuæ, instead of Lard Oil.

Pilulæ Antimonii Compositæ, Plummer's pills. Each pill contains Sulphurated Antimony, Calomel, āā gr. ½, Guaiac gr. j.

**Black Wash*, Calomel, ʒj, Lime-water Oj, producing the Black Oxide of Mercury. **Yellow Wash*, Corrosive Sublimate ʒss, Lime-water Oj, producing the Yellow Oxide of Mercury.

Triturations of the metal itself, its chlorides or oxides, may be prepared according to the general pharmacopœial formula,—and will be found exceedingly efficient preparations.

Incompatibility of the Chlorides of Mercury. They are incompatible with almost everything. Corrosive Sublimate is easily decomposed, and the combination of Calomel with Muriatic Acid or Chlorides is apt to produce Corrosive Sublimate.

Antidote to the Mercurial Salts. Albumen,—the white of one egg to 4 grains of Corrosive Sublimate, an excess redissolving it. Prompt emesis is also necessary, after giving albumen.

Physiological Actions. Mercury is easily absorbed in any form; is excreted by the liver (in which it tends to accumulate while stimulating its cells), also by the intestinal and salivary glands, the kidneys, and partly by the skin. It has a selective action on the glands, especially the salivary and the pancreas, which it stimulates to the production of pathological secretions.

In Small Doses, Mercurial salts are blood tonics, increasing the number of the red corpuscles. They promote waste by stimulating the lymphatic system, and in very small doses are sedative to the mucous membranes. *In Medium Doses*, they have a selective cathartic action, and increase the flow of bile by reflex action on the bile ducts, as do resinous purgatives. *In Full Doses, continued*, they over-stimulate the glands, especially the pancreas, producing pathological secretions, impair the ozonizing function of the blood, diminishing the red corpuscles, and produce a low inflammation in the nervous tissue, resulting in loss of coördination power.

Corrosive Sublimate, in small doses, prevents hyperplasia of the connective tissue, and causes, in large doses, inflammation and ulceration of the lower bowel. It is a powerful gastro-intestinal irritant, and poisonous also to the cardiac muscle. It is an effective parasiticide, and one of the most efficient of all the antiseptics.

Calomel is very insoluble, and unirritating. It is tasteless, laxative in grain doses, an efficient diuretic, and acts especially on the excrementitious intestinal glands.

The *Red Iodide* and the *Cyanide* are irritant poisons. The *Acid Nitrate* is a good escharotic, its pain being transient though severe.

Salivation (ptyalism) is produced most readily by Blue Mass, next by Calomel, and least so by Mercury with Chalk. Its first symptoms are sore teeth, spongy gums, profuse saliva, fetid breath, bluish line along margins of the teeth; then swelling of the glands, aching jaws and muscles, and fever, resulting in emaciation, marked anæmia, falling of the hair, ulcerated skin, fetid diarrhœa, trembling, obscure, nervous phenomena, albuminuria, and in women abortion, through impoverished blood.

Therapeutics. Mercury is undoubtedly a specific in—

Syphilis, in which it is best given in small doses to just short of ptyalism, then stopped, but renewed, and so continued for some time. The Green Iodide in small doses (gr. $\frac{1}{10}$–$\frac{1}{6}$ ter die) with Opium, the best for internal administration. It is not applicable to the tertiary form; therein Potassium Iodide is the remedy.

Tonsillitis, *Parotitis*, and other acute glandular inflammations may often be cured rapidly by Calomel, gr. $\frac{1}{20}$, or Gray Powder, gr. $\frac{1}{3}$, every two hours.

Irritable Stomach, vomiting, etc., Calomel in small doses, gr. $\frac{1}{20}$–$\frac{1}{10}$.

Gastric Ulcer,—Corrosive Sublimate, gr. $\frac{1}{60}$–$\frac{1}{30}$, ter die, is effective.

Ileo-colitis of Infants,—gr. $\frac{1}{5}$ of Gray Powder, or Calomel, gr. $\frac{1}{20}$–$\frac{1}{12}$.

Dysentery of Adults, stools slimy and bloody,—Corrosive Sublimate, gr. $\frac{1}{100}$.

Diphtheria,—Calomel in large doses, or the Cyanide, in doses of gr. $\frac{1}{100}$–$\frac{1}{50}$, have many advocates, and are undoubtedly efficient.

Membranous Laryngitis,—the Subsulphate (gr. iij–v) as emetic.

Typhoid Fever,—Calomel, a 10-grain dose each day for three days, is antipyretic. This is the German specific typhoid treatment.

Hepatic Cirrhosis,—Corros. Sublim., gr. $\frac{1}{30}$ ter die, in the first stage.

Skin Diseases, as psoriasis, herpes, pruritus, acne, pityriasis, etc.,—ointments of Calomel, Corrosive Sublimate, and the Iodides.

Parasitic Skin Diseases,—Corrosive Sublimate lotions, gr. ij ad ℥j; or a five per cent. solution of the Oleate with $\frac{1}{8}$ part of Ether.

Conjunctivitis,—Ointment of the Yellow Oxide, or Brown Citrine Oint.

Goitre, Enlarged Spleen,—Oint. of the Red Iodide, rubbed in with heat.

Antiseptic Solution,—Corrosive Sublimate gr. vijss to a quart of hot water, makes a solution of 1 in 2000,—to a pint, 1 in 1000. *Wyeth's Antiseptic Tablets*, each contain this amount, and are very convenient, besides almost compelling accuracy in the preparation.

AURUM,—Gold.

Preparations.

Auri et Sodii Chloridum. Dose, gr. $\frac{1}{30}$—$\frac{1}{15}$ in pill. Is in fact a subchloride.

**Auri Chloridum*, Chloride of Gold, gr. $\frac{1}{60}$—$\frac{1}{30}$. Best given in solution.

Triturations of the metal itself may be prepared according to the general formula of the U. S. P. for Triturations.

Physiological Actions. They resemble the effects of Mercury closely. *In Small Doses*, the Salts of Gold promote appetite and digestion, stimulate the cerebral functions, and produce a marked mental exhilaration, a sense of well-being. Continued, they induce aphrodisiac effects in both sexes, and in women an increase of the menstrual discharge. *Full Doses* cause nausea and vomiting, glandular irritation, salivation without loosened teeth or sore gums, increased urine, sweats, and fever (the auric fever); nutrition is impaired, and rapid waste set up. *Toxic Doses* produce effects similar to those from Corrosive Sublimate, violent gastro-enteritis, mental disturbance, convulsions, priapism, trembling, paralysis.

Poisoning by the Chloride of Gold is treated by *Albumen* or flour, and evacuation of the stomach, just as in the case of Hydrarg. Chlor. Corr.

Therapeutics. The Salts of Gold are useful in—

Irritative Dyspepsia, with red glazed tongue, epigastric pain, diarrhœa.

Gastro-duodenal Catarrh is much benefited by very small doses.

Hepatic and Renal Sclerosis, and especially in the chronic fibroid kidney, the salts of Gold in small doses are extremely valuable, if given in the incipiency, as they prevent hyperplasia of connective tissue (?).

Hypochondriasis, is best treated by the auric preparations in small doses.

Amenorrhœa, and Impotence, of the functional kind, may be cured by it.

Syphilis, especially its tertiary ulcerations, and syphiloma of bones, etc., after other ineffectual treatment, try the Chloride of Gold.

COLCHICUM,—Meadow Saffron.

Source and Composition. The corms and seeds of *Colchicum autumnale* (nat. ord. Melanthaceæ). It contains an alkaloid, *Colchicine* (converted into *Colchicein* by acids), Tannic and Gallic Acids, Starch, Sugar, and a Resin.

Preparations. Those of the seeds are the most reliable.

Vinum Colchici Seminis, Wine of Colchicum-seed,—Dose, ♏x–xxx. This wine has a drug-strength of only 15 per cent., while the next has 40 per cent., and still this is the most reliable of the two.

Vinum Colchici Radicis, Wine of Colchicum-root.—Dose, ♏v–xv–xxx.

Extr. Colchici Sem. Fl., ♏j–v. *Extr. Colchici Rad. Fl.,* ♏v–xx.

Tinctura Colchici Seminis, ♏v–xx. *Colchicina,* Colchicine,—gr. $\frac{1}{120}$–$\frac{1}{60}$.

Physiological Actions. Colchicum is a drastic purgative, emetic, diuretic, diaphoretic, a gastro-intestinal irritant, and a cardiac depressant. Its taste is bitter and acrid. *In Small Doses* it increases secretion, especially the urine and the perspiration. *In Full Doses* its action is emeto-cathartic, producing profuse watery discharges, great nausea, and muscular feebleness. *In Large Doses* it is a powerful gastro-intestinal irritant, causing griping, choleraic discharges, lowered arterial tension, and depression of the heart by reflex action over the distribution of the pneumogastric. Then great prostration, convulsions and collapse, death from exhaustion, with consciousness preserved until carbonic acid narcosis sets in. On the excretion of uric acid and urea its influence is a greatly disputed question; but it probably increases the flow of bile.

Treatment of Colchicum Poisoning. Emesis and catharsis. Warm drinks freely. *Tannic Acid* as an antidote. *Morphine* hypodermically, to sustain the heart.

Therapeutics. Colchicum is a specific palliative in—

Acute Gout, in which it should be given with an alkali, and kept short of emeto-catharsis. It does not prevent relapses, and its power is weakened by repetition in this disorder. The alkaloid is probably the most effective preparation in this disease, given in granules of gr. $\frac{1}{60}$, four daily.

Ascites, due to obstructive disease of the liver,—Colchicum in full doses, with Opium to sustain the heart, is most effective, from the profuse drain which it establishes.

Portal Congestions are relieved by Colchicum given with a saline purgative, as it markedly depletes the portal circulation.

Cerebral Congestion of acute type,—Colchicum as a revulsive purgative.

Acute Rheumatism,—Colchicum is often very efficient, but frequently fails, and at any rate should not be long administered in this affection.

GUAIACUM,—Lignum Vitæ.

Source and Composition. It is the heart wood of *Guaiacum officinale*, a West India tree (nat. ord. Zygophyllaceæ), and contains 60–70 per cent of *Resin* (Guaiaci Resina) which consists of 3 Acids, *Guaiaconic*, *Guaiaretic*, *Guaiacic*; also 4 Sub-resins, and a yellow Coloring-matter.

Preparations.

Guaiaci Lignum, Guaiac Wood,—Used in decoction.
Guaiaci Resina, Resin of Guaiac, gr. v–xx, in wafer, or pill.
Tinctura Guaiaci, ♏x–ʒj. *Tinct. Guaiaci Ammoniata*, ♏v–ʒss.

Physiological Actions. Guaiac is diaphoretic, expectorant and alterative. Its taste is acrid and very disagreeable. It irritates the gastric mucous membrane, increasing its mucus, salivates by reflex action, and stimulates the intestinal secretions and the flow of bile. Though a colloidal body it enters the blood, producing diaphoresis, and stimulating the excretory glands and the production of bronchial mucus. Its continued use produces gastric catarrh, and in large doses it causes vomiting, purging and severe congestive headache.

Therapeutics. It is a valuable remedy in—

Tonsillitis to abort the attack,—ʒss of Tincture every 4 hours.
Neuralgic Dysmenorrhœa,—Guaiac is promptly alleviative.
Chronic Rheumatism,—in which it has an established reputation.
Syphilis,—it has been well used in the form of the Compound Decoction of Sarsaparilla, of which Guaiac is an ingredient.

STILLINGIA,—Queen's Root.

Source and Composition. It is the root of *Stillingia sylvatica*, an indigenous plant of the nat. ord. Euphorbiaceæ; and contains a Resin and a Volatile Oil, but the active principle has not yet been isolated.

Preparations. They should be made from the fresh root, as those from the dried root are almost inactive. Dose of the powdered root, gr. x–ʒj.

Extractum Stillingiæ Fluidum, ♏x–ʒj. * *Tinctura Stillingiæ*, ʒss–ij.

Physiological Actions. Stillingia is expectorant, diaphoretic, diuretic, purgative, cholagogue, sialogogue and alterative. Its taste is acrid and pungent. It increases the action of the heart, skin, kidneys, and bronchial mucous membrane; and the gastric, hepatic, intestinal and salivary secretions. Full doses excite epigastric pain, nausea and vomiting.

Therapeutics. It is considered valuable in—

Strumous and Syphilitic Affections,—as an alterative, with Sarsaparilla.
Ascites from hepatic changes,—in full doses it rapidly removes the fluids.

Portal Congestions of malarial origin, torpid liver, and jaundiced skin.

Constipation due to deficient intestinal secretion,—it is often very useful.

Hemorrhoids due to hepatic obstruction, or to chronic constipation.

Intermittents,—the Fluid Extract with Quinine or Arsenic is a very useful combination. A strong decoction is said to ward off an impending paroxysm of ague, if administered early enough.

SANGUINARIA,—Blood-root.

Source and Composition. It is the rhizome of *Sanguinaria Canadensis*, (nat. ord. Papaveraceæ) and contains 3 alkaloids,—*Sanguinarine* (identical with Chelerythrine, from Chelidonium Majus), *Porphyroxine* and *Puccine*,—combined with *Chelidonic and Sanguinarinic Acids;* also a Resin, Gum, Albumen, Sugar, etc. The salts of its alkaloids are of brilliant red and orange colors, and are all soluble in water.

Preparations.

Tinctura Sanguinariæ, Tincture of Sanguinaria,—Dose as an expectorant, ♏v–xx; as an emetic, ʒj–iij.

Extr. Sanguinariæ Fluidum,—Dose, ♏j–v–xxx as emetic, cautiously.

**Sanguinarina*, *Sanguinarine*, gr. $\frac{1}{12}$–$\frac{1}{8}$. Gr. ½ is an emetic dose, if repeated every 10 minutes for 2 or 3 doses.

Physiological Actions. Sanguinaria is sternutatory, sialogogue, and a systemic emetic; also an expectorant, an emmenagogue, a cardiac paralyzer, a violent irritant, an acro-narcotic, and an alterative.

Its taste is bitter and acrid. It causes violent sneezing, increases secretion by irritating the secretory organs as it is eliminated, and produces salivation, catharsis, and emesis with great depression. Full doses are violently irritant, the heart's action being first increased, then depressed, and finally paralyzed by stimulation of its inhibition. It decreases the reflexes by paralysis of the spinal centres, causes dilatation of the pupils, lowered temperature, cold sweats, great thirst, collapse, and death by paralysis of the cardiac and respiratory centres, frequently preceded by convulsions. Locally it is a feeble escharotic.

Therapeutics. Sanguinaria is well employed in—

Chronic Nasal Catarrh,—gtt. x of tinct. ter die, also powder locally.

Acute Bronchitis and Asthma,—as an expectorant, with Lobelia, etc.

Chronic Bronchitis,—Sanguinaria is a most serviceable remedy.

Catarrhs of the duodenum and biliary ducts,—it is very useful.

Atonic Dyspepsia, gtt. ij–iij of the Tincture, or gr. $\frac{1}{12}$ of Sanguinarine.

Functional Impotence from irritability,—combined with Stillingia.

Amenorrhœa of functional character, in non-plethoric subjects.
Croup,—in which many authorities rank it a specific remedy.
Pneumonia, of typhoid type,—after acute symptoms subside.
Scarlatina,—the decoction, as a gargle for the sore throat, is very efficient.
Nasal Polypi, after their removal,—Sanguinaria by insufflation.
Hypertrophy of the nasal mucous membrane,—Sanguinaria by insufflation.
Ulcers and fungous granulations,—the powdered drug, locally.
Strumous and Syphilitic Affections,—it is a good alterative.

XANTHOXYLUM,—Prickly Ash.

Source and Composition. The bark of *Xanthoxylum fraxineum* (nat. ord. Rutaceæ). It contains an alkaloid,—*Xanthoxyline* (identical with *Berberine*),—a Volatile and a Fixed Oil, Gum, Resin, etc. Dose, gr. x–xxx.

Preparations.

Extractum Xanthoxyli Fluidum, ♏x–ʒij. * *Decoctum Xanthoxyli*, ℥j to the quart. Dose, a pint during 24 hours in divided doses.

Physiological Actions. The taste of Xanthoxylum is aromatic, soon becoming acrid and bitter. It is a local and systemic sialogogue, causing profuse salivation, with tingling in the tongue, and increased secretion from stomach, intestines, liver and pancreas. It is also diaphoretic and diuretic, increases the action of the heart, and raises the arterial tension.

Therapeutics. Xanthoxylum is efficient in—

Chronic Pharyngitis,—the Fluid Extr., ♏x–xxx, internally, the Decoction locally, as a gargle,—give very good results in bad cases.
Jaundice from catarrh of the bile ducts,—it is highly serviceable.
Chronic Rheumatism, myalgia, lumbago, etc.,—it has a high reputation.
Constitutional Syphilis is well treated by Xanthoxylum, as an alterative.
Toothache,—the root or bark chewed is a popular remedy.
Paralysis of the Tongue is said to be removed by chewing the root.

MEZEREUM,—Mezereon.

Source and Composition. The bark of *Daphne Mezereum*, a European shrub of the nat. ord. Thymelaceæ. It contains a glucoside,—*Daphnin*—also a Resin, an acrid Volatile Oil, etc.

Preparations. It is a constituent of the official Compound Decoction and Compound Fluid Extract of Sarsaparilla.
Extractum Mezerei Fluidum, ♏v–xxx. *Unguentum Mezerei*, local use.

Physiological Actions. Mezereon is a sialogogue, and, in small doses, laxative and alterative. It is intensely acrid, and in sufficient dosage an irritant poison, causing violent vomiting, purging, nephritis, and gastro-enteritis.

Therapeutics. It has been used with advantage in—

Chronic Rheumatism.
Strumous and Syphilitic Affections.
Toothache.
Paralysis of the Tongue.

*BERBERIS,—Barberry.

Berberis is the root of *Berberis aquifolium*, the Oregon grape, a plant of the nat. ord. Berberidaceæ, indigenous to the Pacific slope. Its activity is due to its alkaloid, *Berberine*, which is found in several other plants, viz.—Hydrastis, Coptis, Podophyllum, Menispermum, Calumba, Xanthoxylum, etc.

Preparations. Those found in the shops are the—

**Extractum Berberidis Fluidum*, Fluid Extract of Berberis,—Dose, ♏v–xxx.
**Tinctura Berberidis*, Tincture of Berberis,—1 to 5. Dose, ♏x–ʒj.
**Berberina*, Berberine, the alkaloid,—usually occurs in commerce as a Hydrochlorate, prepared from Hydrastis, and called "Hydrastin." Dose, gr. j–x.

Physiological Action and Therapeutics. Berberis is an astringent bitter, in small doses a tonic and stomachic, but in large ones it is cathartic, producing watery discharges with much abdominal pain. It is generally considered to have a high degree of alterative power. The alkaloid is astringent and antiseptic, in full doses is a gastro-intestinal irritant, and has some value as an antiperiodic.

Berberis has been used as an internal remedy for typhoid and malarial fevers, diarrhœa, dyspepsia, and the uric acid diathesis, with tendency to formation of calculi. It has given better satisfaction, however, as an alterative tonic in strumous and syphilitic affections, and locally as an application in conjunctivitis. The *Muriate* (*Hydrochlorate*) *of Berberine* is a favorite application to the urethral mucous membrane, as an antiseptic and astringent injection in gonorrhœa.

*FUCUS VESICULOSUS,—Sea-wrack.

Fucus Vesiculosus is a perennial plant of the order Algæ, commonly called *Bladder-wrack* or *Sea-wrack*, which grows as a sea-weed along the coast, and may be easily recognized by its flat leaf, with a midrib throughout its length, and in it a number of small spherical vesicles, filled with air. It contains mucilage, soda and Iodine, but less of the latter than is found in other algæ which inhabit deeper water. A *Decoction* of the plant is the best form in which to administer it.

Therapeutics. Fucus was formerly official in the Irish Pharmacopœia, and has been employed as an alterative and tonic in goitre, psoriasis, glandular enlargements, etc., but more especially to produce the absorption of adipose tissue, an extract being largely sold as a remedy for obesity, under the name of "Anti-fat."

SARSAPARILLA,—Smilax.

Source and Composition. The root of Smilax officinalis, (nat. ord. Smilaceæ), a vine growing in Honduras, Brazil, etc. It contains a principle, —*Smilacin, or Parallin,*—from which is derived another,—*Parigenin,*—also an Essential Oil, Calcium Oxalate, Starch, Resin, etc.

Preparations. The most important are the following, viz.—

Extractum Sarsaparillæ Fluidum. Dose, ʒss–ʒj.

Decoctum Sarsaparillæ Compositum, contains also Guaiac, Sassafras, Mezereon and Liquorice. Large doses are necessary. Dose, ℥ij–iv.

Syrupus Sarsaparillæ Compositus, ʒj–v; contains also Guaiac, Rose, Senna, Liquorice, Sassafras, Anise and Gaultheria.

Physiological Actions. Negative results have followed the most carefully executed experiments made with this drug and its principles. It probably has no activity, though by some it is considered to be an efficient diaphoretic, also diuretic, tonic and alterative.

Therapeutics. Formerly held in repute as an alterative, it was much used as a "blood-purifier" in domestic practice, and by surgeons in the scrofulous and syphilitic cachexiæ. Its value is probably due to its being generally used as a warm decoction in large quantities, the warm water causing increased elimination of waste products, promoting the renal and cutaneous circulation, and thus producing diaphoresis and diuresis. In—

Chronic Syphilis, it may be well used as an adjuvant to Mercury in the second stage, or as a vehicle for Potassium Iodide in the tertiary form. The Syrup is the best vehicle to disguise the taste of Potassium Iodide.

ASTRINGENTS.

TANNIC AND GALLIC ACIDS.

Preparations.

Acidum Tannicum, Tannic Acid, Gallo-tannic Acid, Tannin; gr. j–x.

Unguentum Acidi Tannici, has 1 part of T. to 9 of Benzoated Lard.

Suppositoria Acidi Tannici, have 1 part of T. to 5 of Cacao-butter.

Acidum Gallicum, Gallic Acid, gr. x–xxx. Soluble in 100 of cold water.

Unguentum Acidi Gallici, has 1 part of G. to 9 of Benzoated Lard.
**Glyceritum Acidi Tannici*, contains 1 part of Tannin to 4 of Glycerin.
**Glyceritum Acidi Gallici*, contains 1 part of Gallic Acid to 4 of Glycerin.

Difference between Tannic Acid and Gallic Acid. According to some authorities the difference is one of oxidation; Tannic Acid, when oxidized, being converted into Gallic Acid. According to others Tannic Acid is simply Gallic Acid Anhydride, and the difference is one of hydration. Tannic Acid is the most powerful of the two as an astringent. It coagulates albumen and gelatin, while Gallic Acid does not. It is, however, converted into Gallic Acid in the stomach before absorption.

Source and Extraction. Tannic Acid is obtained from the galls of the Dyer's Oak, (Quercus lusitanica), by treatment with Ether. Gallic Acid is obtained from the same galls, after exposure in a warm place for a month; or from Tannic Acid by the action of dilute Sulphuric Acid.

VEGETABLE ASTRINGENTS, nearly all contain some form of Tannic or Gallic Acid, on which their physiological and therapeutical properties depend. The principal ones are the following-named, to wit,—

Galla, Nut-gall.—The gall of *Quercus lusitanica*. Composition, Tannic Acid 60–70 per cent., Gallic Acid 3 per cent., Ellagic Acid, Pectin, Sugar, Starch, etc. *Tinctura Gallæ*, ʒ ss–ij. *Unguentum Gallæ.*

Hæmatoxylon, Logwood. Contains Tannic Acid, Hæmatoxylon, etc. *Extractum Hæmatoxyli*, gr. v–xx. **Decoctum Hæmatoxyli*, ℥ j–ij.

Krameria, Rhatany,—The root of *Krameria triandra*. Contains Rhataniatannic Acid, Rhatanine, wax, gum, etc.
Tinctura Krameriæ, ♏v–ʒ ss. *Extr. Krameriæ Fluidum*, ♏v–ʒ ss.
Trochisci Krameriæ, j–iij. *Syrupus Krameriæ*, ʒ j–iv.

Hamamelis, Witch-hazel,—The leaves of *Hamamelis virginica*. Contains Tannic Acid, 8 per cent., a bitter principle, etc.
Extractum Hamamelidis Fluidum, ♏ij–ʒ j.
**Pond's Extract*, a proprietary, aqueous preparation, of uncertain composition and strength.

Quercus Alba, White-oak Bark. Contains Quercitannic Acid, Quercin, etc., but no Gallic Acid. No official preparations.

Catechu,—An extract from the wood of *Acacia catechu*. Contains Catecutannic and Catechuic Acids.
Tinctura Catechu Composita, ♏x–℥ j. *Trochisci Catechu*, j–iij.

Kino,—The juice of *Pterocarpus Marsupium.* Contains Kino-tannic Acid, Kinoin, etc.

Tinctura Kino, ♏x–ʒ ij. **Pulvis Kino Compositus,* gr. v-xx.

Geranium, Cranesbill,—The rhizome of *Geranium maculatum.* Contains Tannic and Gallic Acids, and possesses a rather pleasant taste.

Extractum Geranii Fluidum, ♏v–ʒ j.

Rosa Centifolia, Pale Rose,—The petals of *Rosa centifolia,* the cabbage rose. Contains Tannic Acid, a volatile oil, etc.

Aqua Rosæ. Unguentum Aquæ Rosæ.

Rosa Gallica, Red Rose,—The petals of *Rosa gallica.* Contains Tannic and Gallic Acids, the volatile oil, Quercitrin, etc.

Extr. Rosæ Fluidum, ♏v–ʒ j. *Syrupus Rosæ,* Syrup of Rose.
Confectio Rosæ, Confection of Rose. *Mel Rosæ,* Honey of Rose.

Rubus, Black-berry,—The bark of the root of *Rubus villosus,* and other varieties of Rubus. Contains Tannic Acid, 10 per cent., etc.

Extractum Rubi Fluidum, ♏x–ʒ j. *Syrupus Rubi,* ʒ j–℥ j.

Castanea, Chestnut,—The leaves of *Castanea vesca.* Contains Tannic and Gallic Acids.

Extractum Castaneæ Fluidum, ʒ ss–ij.

Granatum, Pomegranate,—The bark of the root of *Punica Granatum.* Contains Punico-tannic Acid in large quantity; also Tannic Acid, Mannite, and the alkaloid *Pelletierine,* which is used as a tæniafuge. No official preparations.

**Extractum Granati Fluidum,* ʒ ss–jss. **Decoctum Granati,* ℥ ij–iv.

***Coto Bark,**—is the bark of an unknown Bolivian tree, and contains no tannin but does an acrid, bitter principle, named *Cotoin.* It is decidedly irritant to the skin and mucous membranes, but is highly recommended as an astringent in most forms of diarrhœa, especially that of phthisis, cholera and typhoid fever. The tincture, in small doses (♏j–v), is used in diarrhœa of children. Paracoto Bark contains *Paracotoin,* and has similar properties. Dose, of fluid extract, ♏j–x or xv,—of Cotoin, gr. ½–ij, of Paracotoin, gr. iv–v.

***Mango,** Bark of *Mangifera Indica,*—is supposed to act as an alterative astringent, with special tonic action on mucous membranes, and has been used in nasal catarrh, endometritis, vaginal leucorrhœa, diarrhœa and dysentery. It is said to check profuse menstruation, and also the hæmorrhage following on abortion. Dose, of the fluid extract, ♏x–ʒ j. *Mango-fruit,* or *Mangosteen* is the fruit of another Indian tree, the Garcinia mangostana. It is a powerful astringent, and is used for nasal and vaginal catarrhs, diarrhœas, etc.

***Yerba Reuma,** *Frankenia grandiflora,*—this Californian plant is recommended as a highly efficient astringent in diseases of the mucous membranes, especially in chronic nasal catarrh, gonorrhœa, leucorrhœa and dysentery. It is used, locally, ʒ ij of the fluid extract to ℥ iv of water. Dose, internally, ♏x–xx.

***Sarracenia Flava,** Trumpet plant, Pitcher plant,—has been well employed in dyspepsia, various diarrhœas, and chronic nasal catarrh, also as an astringent injection in gonorrhœa and leucorrhœa. Dose, of the fluid extract, ♏x–℥j.

***Pinus Canadensis,** Canadian Pine,—properly the *Abies Canadensis* or Hemlock Spruce, of the U. S. and Canada,—is the basis of a preparation named the **Concentrated Extract of Pinus Canadensis,*—an aqueous, non-irritant astringent, said to have a specific tonic action upon mucous membranes. Two kinds are sold, one being called the "White" Extract,—in reality a golden yellow,—and the other the "Dark" Extract,—the former intended for use when it is desirable to avoid staining the linen. This preparation received the endorsement of Dr. J. Marion Sims, and has been extensively employed both locally and internally, as a topical application in uterine and vaginal catarrhs, and as a systemic remedy in catarrhal inflammation of the gastro-intestinal and broncho-pulmonary mucous membranes.

***Statice,** Marsh Rosemary,—Root of *Statice limonium,*—has Tannic Acid.

***Alnus,** Alder,—Bark of *Alnus serrulata,*—has Tannic Acid, oil, resin, etc.

***Heuchera,** Alum-root,—Root of *Heuchera Americana,*—has Tannic Acid.

***Nymphæa,** Water-lily,—Root of *Nymphæa Odorata,*—has both Tannic and Gallic Acids, etc. **Decoctum Nymphææ,* ℥ss–j.

***Diospyros,** Persimmon,—Unripe fruit of *Diospyros Virginiana,*—has Tannic Acid.

Physiological Actions. *Tannic Acid* is a more powerful astringent than Gallic Acid. It precipitates pepsin and coagulates albumen, impairs digestion, stops peristalsis, and causes constipation. It enters the blood as Gallic and Pyro-gallic Acids, being converted into these by the organism. It is a crystalloidal body, but combines with colloids; and is a valuable antidote in poisoning by the alkaloids and Tartar Emetic, with which it forms nearly insoluble tannates. Its continued use disorders digestion, irritates the mucous membranes, and produces emaciation. Injected into the veins it causes death by the formation of emboli.

Gallic Acid is a much less powerful astringent, and does not coagulate either albumen or gelatin.

Hæmatoxylon is a mild astringent, of sweetish taste, producing blood-red stools and urine. It does not constipate nor disorder the bowels, but has caused phlebitis.

Hamamelis seems to have special power in restraining venous hemorrhages, a property not wholly due to its Tannic Acid. In large doses it causes severe throbbing pain in the head.

Therapeutics. Tannic Acid is best used locally, and for astringent effect on the intestinal canal; Gallic Acid systemically, and for action on remote parts. In the following disorders they have proven specially efficient.

Hemorrhoids, and hemorrhages from the lower bowel,—Tannic Acid locally and internally; or Hamamelis as an injection.

Hematemesis, not due to inflammation,—Tannic Acid, gr. x–xx in solution, taken in two or three divided doses.

Hematuria, and distant passive hemorrhages,—Hamamelis or Gallic Acid internally, are very efficient, and may usually be relied upon.

Epistaxis,—Hamamelis has long been employed successfully.

Albuminuria,—Gallic Acid, to restrain the waste of albumen.

Rectal Fissures and Ulcers,—Tannic Acid or its glycerite. Rhatany was a favorite with Trousseau in these affections.

Catarrhs, and chronic local affections of the mucous membranes,—Glycerite of Tannin, or better still, Tannic Acid alone, by insufflation, or the extract of Pinus Canadensis.

Gastric Catarrh, *Pyrosis*, *etc.*,—Tannic Acid or Kino, internally.

Endocervicitis, *Leucorrhœa*, *etc.*,—Tannic Acid with Iodoform.

Conjunctivitis—powdered Tannin after the acute stage has passed. Also excellent in corneal ulcers and granular lids.

Dysentery and Diarrhœas, acute and chronic,—Tannic Acid with Opium, or Catechu, internally,—Hæmatoxylon for diarrhœas of children.

Whooping-cough,—Castanea in decoction, taken *ad libitum*.

Skin Diseases, as eczema, impetigo, intertrigo,—the Glycerite of Tannin.

Otorrhœa,—the Glycerite of Tannin is very serviceable in this affection.

Varicose Veins and Ulcers,—Hamamelis is satisfactorily employed.

ARGENTUM,—Silver.

Preparations.

Argenti Oxidum, Oxide of Silver. Dose, gr. ss–gr. ij. Is nearly insoluble in water, and is not dangerous as an internal remedy.

Argenti Nitras, gr. $\frac{1}{6}$–$\frac{1}{2}$, if watched, up to gr. j. Is best given in pill or distilled water; never with Tannin or a vegetable extract, lest an explosive compound result. *Argenti Nitras Fusus,* Melted stick, Lunar Caustic,—for local use. *Argenti Nitras Dilutus,* Mitigated Nitrate of Silver, used locally by ophthalmologists. Is one-half Nitrate of Potassium.

Argenti Cyanidum, Cyanide of Silver,—is only used with a mineral acid, to make Hydrocyanic Acid extemporaneously.

Argenti Iodidum,—Iodide of Silver. Dose, gr. $\frac{1}{4}$–gr. j. Is supposed not to discolor the skin, if taken continuously.

Incompatibles. The Nitrate is exceedingly sensitive to organic matter and light, and decomposes readily. All soluble Chlorides are incompatible with it, precipitating the Chloride of Silver; hence it should be given in distilled water. Most mineral Acids and their salts, Alkalies and their carbonates, Aqua Calcis, and Astringent Infusions are also incompatible with the silver salts.

Antidote to the Silver Salts. Common Salt freely, it precipitating the insoluble chloride of silver, and also acting as an emetic.

Physiological Actions. Nitrate of Silver combines with the albumen of the tissues and is a limited escharotic. It excites superficial inflammation, and stains the part black under the influence of light. The stains may be removed by washing with a strong solution of Potassium Cyanide.

In Small Doses it increases secretion, stimulates the heart, promotes nutrition, and acts as a nerve tonic. *Its Continued Administration* produces gastro-intestinal catarrh, waste of tissue, uræmia, albuminuria, fatty degeneration of the heart, liver and kidneys, hemorrhages, fluidity of the blood, a slate-colored line along the gums, and a similar discoloration of the skin and mucous membranes, with centric impairment of the nervous system, causing paralysis on a large scale, loss of coördination, convulsions, and finally death by paralysis of respiration. These symptoms are collectively termed *Argyria.*

Large Doses produce violent gastro-enteritis, and ulcer of the stomach, from thrombosis of its veins.

Regulation of a course of Silver Medication. The administration of the remedy should be suspended after five or six weeks, and elimination promoted by purgatives, diuretics and baths. To prevent the general discoloration, Potassium Iodide should be given conjointly with the silver, and baths of Sodium Hyposulphite used.

Therapeutics of the Silver Salts. Locally the Nitrate is much used as a stimulant application, an astringent, a caustic, an alterative, and an antiphlogistic. A solution in Nitrous Ether (gr. xl ad ℥j) will abort—

Superficial Inflammations, if applied early to the neighboring integument.

Erysipelas, by Higginbotham's method, the solution (gr. xx ad ℥j) applied over the inflamed surface and beyond, after careful washing and drying.

Throat Diseases,—the Nitrate is used, but salts of Copper are better.

Ulcers of the tongue and tonsils,—the solid stick may be applied locally.

Dyspepsia, with vomiting of yeasty fluid,—the Nitrate internally.

Chronic Gastritis and Gastric Ulcer,—the Oxide in ½ grain doses ter die. The Nitrate may be combined with Belladonna or Hyoscyamus in chronic gastric catarrh, in which it is often very efficient.

Dysentery of chronic type, especially if rectal ulcer,—the Nitrate internally and by enema, is one of the best remedies.

Diarrhœa, of phthisis and typhoid fever,—the Nitrate with Opium.

Conjunctivitis,—solutions of various strengths (gr. j–x ad ℥j of distilled water); when corneal ulcers exist, it must be cautiously used, or opacities due to deposits of the metal will remain in the cornea.

Chronic Spinal Inflammations, causing locomotor ataxia or paraplegia,—the Nitrate has in some few cases effected permanent cures.

Epilepsy, was formerly much treated with the Nitrate, and it occasionally achieved the most brilliant results.

CUPRUM,—Copper.

Preparations.

Cupri Sulphas, Blue Vitriol. Dose, gr. $\frac{1}{16}$–$\frac{1}{4}$; as emetic, gr. vj–xij.

Cupri Acetas,—for local use. *Verdigris* is an impure subacetate.

**Cuprum Ammoniatum*, gr. ⅛–¼, or more when tolerance is established.

Treatment of Copper Poisoning. Metallic copper (as a penny), is best let alone; it will pass the anus in due time without serious symptoms. The *Antidotes* to the salts of copper are the Ferro-cyanide of Potassium, and Alumen. Prompt evacuation by emetics or the stomach pump is necessary. Then Potassium Iodide, even to saturation of the system.

Physiological Actions. The Salts of Copper are gastro-intestinal irritants, causing a metallic taste, nausea with vomiting of greenish matters, purging of blood and mucus, constricted fauces, depressed heart action, hurried respiration, fever. Or, as in the case of Arsenic, no gastro-enteritis may occur but instead profound nervous symptoms, as headache, defective coördination, coma, convulsions, ending in death.

The symptoms of chronic poisoning are bronchial irritation and catarrh, gastro-intestinal catarrh, colic with diarrhœa [*Lead*, colic with constipation], dysentery, nausea, waste of tissue, anæmia, salivation, and a green line (sulphide) along the margin of the gums in those who do not brush their teeth. The nervous symptoms are also usually well marked. *The Liver* becomes atrophied, from the irritation of its connective tissue, and fatty degeneration of the hepatic cells. *The Lungs* are congested, even pneumonic consolidation being set up; Copper seeming to have a selective affinity for the parenchyma of these organs.

Therapeutics. The Sulphate is the best emetic in—

Narcotic and Phosphorus Poisoning,—gr. xij in ℥iv of water, a teaspoonful being given every ten minutes until emesis is set up. Also in *Croup*.

Chronic Dysentery and Acute Diarrhœa,—the Sulphate in doses of gr. $\frac{1}{16}$–$\frac{1}{12}$ with Opium, is the best metallic astringent.

Neuralgia of the 5th, from depression,—Ammoniated Copper valuable.

Gastro-intestinal Catarrh, with diarrhœa,—the Sulphate in small doses.

Pneumonia,—a Tincture of the Acetate is considered curative by Kissel, and was official in the German Pharmacopœia.

Throat Affections, in which weak solutions of the Sulphate are far superior to any other application, even to that of Nitrate of Silver.

Granular Lids and Corneal Ulcers, are best treated by a quick rub with a smooth crystal of Sulphate of Copper, once or twice a week.

Herpes, *Eczema*, *etc.*,—ointments or lotions of the Acetate.

Gonorrhœa,—a weak solution of the Sulphate (gr. ⅛ ad ℥j) is a good injection after the acute stage has passed.

PLUMBUM,—Lead.

Preparations.

Plumbi Acetas, Sugar of Lead. Dose, gr. ¼–v. Soluble in water.

Plumbi Oxidum, Litharge. *Emplastrum Plumbi*, Litharge and Ol. Olivæ.

Plumbi Carbonas, White-lead paint. An excellent local application.

Liquor Plumbi Subacetatis, Goulard's Extract. Is never used internally.

Liquor Plumbi Subacetatis Dilutus, Lead Water. Contains 3 per cent. of Liquor Plumbi Subacetatis. Used externally.

Plumbi Nitras, Nitrate of Lead. Used externally.

Plumbi Iodidum, Iodide of Lead. Used as an ointment.

Treatment of Lead Poisoning. *Acute poisoning*, as by the Acetate, of which ℥j is a toxic dose,—the Sulphates of Sodium or Magnesium are the antidotes; evacuate stomach, and give albuminous drinks and Opium to allay irritation. *Chronic poisoning* is best treated by Iodides to saturation of the system, the Sodium or Calcium being the best. Sulphurated Potassa baths (℥j or more, in water) are also very useful.

Physiological Actions. Astringency is the chief quality of the salts of Lead; they contract muscular tissue, and destroy its contractile power, also lessening secretion they cause colic and constipation. The heart is at first increased in power, but soon slowed, also the respiration. The nervous system is insidiously affected, obscure symptoms, as headache, loss of memory, vertigo, being soon manifested.

Acute Lead Poisoning is rare, the metal itself not being poisonous unless acted on by acids, and the Acetate in large doses being emetic. Intense gastro-intestinal irritation, vomiting, paralysis, coma, collapse, are its principal phenomena.

Chronic Lead Poisoning has its chief sources in *pure* water conveyed by leaden pipes, the use of hair dyes, printing type, etc. Its most prominent symptoms are the blue line (sulphide) along margin of gums, in those who do not clean their teeth, paralysis of the extensor muscles of the forearm (drop-wrist), impaired sensibility, rheumatism without fever or tenderness in the joints,—which, however, are red and swollen,—emaciation, albuminuria, colic, constipation, abortion, gastralgia, aphonia. *Death* may occur from extension of the muscular paresis to the muscles of respiration from the gradual impairment of nutrition;—or from convulsions and coma, a form of the disease known as *Lead Encephalopathy.*

Therapeutics. Chiefly used as an astringent and hemostatic. In—

Skin Diseases, especially eczema, lichen, impetigo, erythema, etc.,—the Liquor Plumbi Subacetatis, part j to iv of Glycerin and Water.

Catarrhal Discharges of muco-purulent character, from the ear, the vagina and the urethra, especially in gonorrhœa and leucorrhœa.

Burns, of small extent, are treated by covering with White-lead paint.

Hemorrhages, as hemoptysis, hematemesis, gastric ulcer, etc., the Acetate in 5-grain doses, every three hours, lowers the heart's action and constringes the local vessels.

Caseous Pneumonia, has been well treated by the Acetate of Lead.

Bronchorrhœa, the Acetate for its astringency, limiting the secretion.

Diarrhœas are commonly treated with the Acetate of Lead; gr. ij with gr. j of pulverized Opium, for choleraic diarrhœa.

Cardiac Hypertrophy,—the Acetate to lower the action of the heart.

Inflammations of external parts are constantly treated by the lotion of "Lead-water and Laudanum;"—though the constituents are chemically incompatible, it is a valuable sedative and astringent.

ZINCUM,—Zinc.

Preparations.

Zinci Oxidum, gr. ss–gr. x, insoluble in water. *Unguentum Zinci Oxidi.*

Zinci Acetas, Acetate of Zinc, gr. $\frac{1}{10}$–gr. ij. Is very soluble in water.

Zinci Sulphas, gr. $\frac{1}{10}$–gr. j. As emetic, gr. vj in ℥iv Aquæ; tablespoonful doses every 5 minutes until emesis occurs.

Zinci Carbonas Præcipitatus, as ointment. **Calamine* is an impure Carbonate of Zinc, formerly a favorite as an ointment for skin diseases.

Zinci Chloridum, is used as a caustic in cancer.

Zinci Valerianas, gr. $\frac{1}{10}$ to gr. ij. *Zinci Phosphidum,*—See PHOSPHORUS.

Physiological Actions. The salts of Zinc are astringents, but milder ones han the salts of Lead. Its soluble salts (the Chloride, Sulphate and Acetate) are corrosive poisons, causing violent gastro-enteritis, and in some cases proound nervous symptoms. *The Chloride* is a powerful and painful escharotic, having great affinity for water, and destroying the albumen of the tissues. *The Sulphate* is a specific emetic, acting promptly and without much depression. Continued use of these salts produces symptoms similar to those of chronic Lead-poisoning, but of less gravity. They do not manifest the same tendency o accumulate in the system as the salts of the other similar metals.

Therapeutics. Zinc salts are used as weak and mild astringents in—

Gonorrhœa,—injections of the Sulphate (gr. j ad ℥j aquæ).

Conjunctivitis,—the Sulphate, with or without Atropine, as a collyrium.

Skin Diseases,—the Oxide and Acetate, as unguents and lotions.

Lupus, Epithelioma, and other malignant growths,—the Chloride as an escharotic, made into a paste with flour and glycerin.

Narcotic Poisoning,—the Sulphate, in a 6-grain dose, is the best emetic.

Diarrhœas and Dysentery,—the Sulphate with Opium and Ipecac., or the Oxide with Pepsin, are efficient, after clearing the canal.

Summer Diarrhœa of children,—the Oxide is an excellent remedy; may be given with Bismuth and Pepsin in powders.

Gastralgia,—the Oxide, gr. v–x, with Aromatic powder and Morphine, is often very efficient, if given half an hour before eating.

Night-sweats of Phthisis,—the Oxide, gr. iij, with Extract. Belladonnæ, gr. ss, at bedtime, is generally effective in preventing them.

Catarrhs of mucous membranes,—the Sulphate in weak solution locally.

Epilepsy, *Neuralgia*, *etc.*, have been successfully treated by the Oxide and the Valerianate.

*CADMIUM.

Physiological Actions. Cadmium is a close analogue of Zinc, but more powerful. It is an escharotic and astringent, also a very depressant emetic. Its effects are those of an irritant poison, with cerebro-spinal symptoms, as coma and convulsions.

Therapeutics. Cadmium is never given internally.

Corneal Opacities are said to be absorbed under the local use of a solution of gr. ij of the Sulphate to ℥j of Distilled Water.

Gonorrhœa, a mild injection of the Sulphate, gr. ¼ to the ℥.

Enlarged Glands, chronic joint affections, cutaneous diseases, nodes and chilblains,—have been successfully treated with an ointment of the Iodide. 1 part to 8 of Lard.

CERIUM.

Physiological Actions of Cerium. The Oxalate has a slightly metallic taste, is sedative to the stomach, and has a selective sedative action on the *motor* distribution of the pneumogastric nerve. It is an insoluble white powder, and is given in doses of gr. j–x, in pill.

Therapeutics. It was introduced by Sir James Simpson as a remedy for vomiting, especially that of pregnancy. It is useful in—

Reflex Vomiting, 5 to 10-grain doses, in the vomiting of pregnancy, also in the vomiting of phthisis and bronchitis; but large doses must be used for seven days, to obtain any decided benefit.

Cough with Vomiting, is remarkably benefited by this salt.

Gastralgia and Diarrhœa,—it may be used instead of Bismuth.

ALUMEN,—Alum.

An Alum is a double Sulphate, formed by the union of a Sulphate of Aluminium, Chromium, Manganum or Ferrum, with a Sulphate of an alkaline metal or group (Potassium, Sodium, or Ammonium).

The Official Alum is *Potassic-Aluminic-Sulphate*, or Potassa-alum ($K_2Al_2\ 4SO_4 + 24H_2O$), which becomes *Alumen Exsiccatum*, Dried Al when the 24 molecules of water are driven off.

Preparations.

Alumen, Alum, Potassa-alum. Soluble in cold water, 1 to 16;—in hot wa 1 to 3. Dose gr. x–xx; as an emetic, ʒj for a child.

Alumen Exsiccatum, Dried Alum, $K_2Al_2(SO_4)_4$. Dose, gr. x–xx.

Aluminii et Ammonii Sulphas, Ammonia-alum. This alum was official in the U. S. Phar. of 1870.

Physiological Actions. Alum is an astringent, stimulating muscular ontraction and coagulating albumen. It first excites the flow of saliva, and hen markedly diminishes it. Coagulating pepsin, it arrests digestion, also tops peristalsis, and usually causes constipation, though sometimes inducing liarrhœa. Although coagulating albumen, even in a weak solution, it enters he blood, constricts the capillaries, arrests secretions, especially those of nucous surfaces, and stops capillary hemorrhage.

In teaspoonful doses Alum is an efficient and non-depressant emetic. In arge doses it is a gastro-intestinal irritant, ℥i⅛ of dried Alum having caused he death of an adult in eight hours.

Therapeutics. It is used locally and internally. In—

Gastric Catarrh,—Alum is useful, especially when there is vomiting of glairy mucus. Grs. iv–viij, in pill, ter die.

Gastralgia, *Enteralgia*, and other neuroses, it is often very efficient.

Chronic Catarrhs,—powdered Alum dusted over the surface.

Leucorrhœa, *Gonorrhœa*,—injections of Alum with Zinc Sulphate and Borax, are commonly recommended, and are efficient.

Hemorrhages of passive character, and at distant points, are well treated by Alum in 15-grain doses internally; also locally if possible.

Hemorrhoids,—a crystal of Alum shaped to fit the rectum.

Croup,—Alum is a good emetic, a teaspoonful in syrup every half hour.

Toothache,—Alum in Nitric Ether (ʒij ad ʒvij), locally, is often efficient.

Bed-sores,—Alum 1 part with 2 of Spiritus Camphoræ and the whites of four eggs, is a very efficient application.

Ulcers, *Sores*, *etc.*, when exuberant granulations, burnt Alum as a caustic.

Colliquative Sweats,—an Alum lotion sponged over the skin.

Catarrhal Ophthalmia, after acute stage,—an Alum lotion, gr. v to the ℥.

Granular Lids,—a crystal of Alum is the very best application.

Lead Colic, and *Constipation*, is most promptly relieved, even cured, by Alum, which acts dynamically, no doubt. It is also a good antidote in Lead-poisoning, being a soluble sulphate.

Administration.—Being a double salt, Alum is easily decomposed when in solution with other salts, the double decomposition which ensues giving rise to insoluble precipitates; therefore it is best administered alone. *Incompatibles* are salts of Iron, Manganese, Bismuth, Antimony, Lead, and salts of most of the alkaloids.

MOTOR-EXCITANTS.

NUX VOMICA.

Source and Composition. The seeds of *Strychnos Nux-vomica,* a East Indian tree of the order Loganiaceæ. It contains 2 alkaloids,—*Strychnine* and *Brucine,* which in the plant are combined with *Igasuric Acid.* Brucine has only $\frac{1}{12}$th the strength of Strychnine, but otherwise corresponds with it physiologically and therapeutically. A third alkaloid—*Igasurine,*—is claimed by some authorities, and denied by others.

Preparations.

Abstractum Nucis Vomicæ, Abstract of Nux Vomica. Dose, gr. $\frac{1}{2}$–j.
Tinctura Nucis Vomicæ, ♏j–v or x, according to the effect desired.
Extractum Nucis Vomicæ, gr. $\frac{1}{8}$–$\frac{1}{4}$. *Extr. Nucis Vomicæ Fl.,* ♏j–v.
Strychninæ Sulphas, Sulphate of Strychnine, gr. $\frac{1}{100}$–$\frac{1}{30}$.
Ferri et Strychninæ Citras, Citrate of Iron and Strychnine, gr. j–iij.
Syrupus Ferri, Quininæ et Strychninæ Phosphatum, ʒj–ij. Contains 1 part of Strychnine in 2500. A powerful tonic.

Treatment of Strychnine-Poisoning. The *Antidote* is Tannic Acid to form the insoluble tannate; or a soluble salt of Iodine. Then emetics or the stomach-pump, followed by *perfect quiet,* which is very important. *Antagonists* are Chloral, Chloroform, Chamomile Oil, Physostigma, Tobacco and Potassium Bromide, the latter being so slow of action that it is rarely available. The bladder must be frequently evacuated, to prevent re-absorption of the poison.

Physiological Actions. *In Small Doses* Nux Vomica acts as a bitter tonic, stimulates respiration, secretion, appetite and digestion, and sharpens the vision. It increases peristalsis, stimulates both the motor and inhibitory apparatus of the heart, and raises arterial tension by stimulating the vaso-motor centres, thus contracting the arterioles; though by full doses the arterioles are relaxed, and the blood-pressure lowered.

By A Full Dose (Strychnine gr. $\frac{1}{10}$), the pupils are dilated, the limbs jerk, respiration becomes spasmodic, and the lower jaw stiff; a sensation of cerebral tension, sudden shuddering and anxiety; the face wearing an unmeaning smile.

A Toxic Dose (gr. $\frac{1}{2}$ for an adult), on an empty stomach quickly produces heightened reflexes; tonic spasms, especially of the extensor muscles, on the least irritation, quickly succeed each other, with intervals of repose; resulting, after two or three hours at most, in death by asphyxia, from tetanic fix tion of the muscles of respiration; consciousness being preserved until CO_2 narcosis sets in.

Strychnine exalts *all* the functions of the spinal cord,—reflex, motor, vasomotor, and sensory,—the latter being least affected. It has selective action on the large multipolar ganglia in the anterior columns, which it stimulates, and then paralyzes by over-stimulation. A large dose destroys the spinal functions as by one blow. It does not affect the brain directly.

Thebaine, the tetanizing alkaloid of Opium, has an action very similar to that of Strychnine, being a powerful spinal exaltant.

Strychnine-spasms are differentiated from Tetanus-spasms—by remembering that the former are intermittent, the latter constant. Furthermore, the meaningless smile, the less marked trismus, the absence of a wound, the rapid course of the symptoms, all point to the action of Strychnine.

Therapeutics. Nux Vomica and its chief alkaloid hold the first rank as a respiratory, cardiac, muscular and nervous stimulant, and as a stomachic tonic. These powerful poisons are equally powerful remedies in—

Atonic Dyspepsia,—Tincture of Nux Vomica, gtt. v ter die, before meals.

Gastric Catarrh, especially that of drunkards,—the Tincture is excellent, and gives them entire satisfaction if a little Capsicum is given along with it.

Opium-poisoning,—Strychnine is powerfully antagonistic to Morphine.

Constipation, when atony of the bowels,—the Tincture in 10-drop doses is very efficient; not as a purgative, but by increasing peristalsis.

Diarrhœas and Dysentery of epidemic type, are well treated by Strychnine.

Vomiting of Phthisis,—Strychnine is generally the very best remedy.

Anæmia and Chlorosis,—Strychnine with Iron and Quinine, is invaluable.

Tetanus, especially the idiopathic type, has been often cured by Strychnine.

Neuralgias, especially the visceral,—Strychnine in very small doses.

Local Paralyses of various types, are well treated by injecting Strychnine hypodermically into the affected muscles, about once a week.

Hemiplegia, not when recent, nor when the muscles have lost their electrical contractility; but when degeneration is about to set in, Strychnine is an excellent remedy.

Diphtheritic Paralyses are almost invariably cured by Strychnine.

Amaurosis, from lead, tobacco or alcohol,—Strychnine has proved useful.

Cardiac Failure from any cause,—Nux Vomica in very small doses.

Dyspnœa from pulmonic affections,—Nux Vomica as a respiratory stimulant.

Intermittents,—as adjunct to Quinine, Strychnine is used advantageously.

Nervous Cough, and the cough of habit,—Nux Vomica is curative.

IGNATIA,—St. Ignatius' Bean.

Source and Composition. The seeds of *Strychnos Ignatii*, or Ignatia Amara, a tree of the order Loganiaceæ found in the Philippine islands. They contain the same ingredients as Nux Vomica, though having a much larger proportion of Strychnine, viz.—about 1 per cent., against ⅓ or ½ per cent. in the latter.

Preparations. The Tincture is the best of the two official ones.

Abstractum Ignatiæ,—Dose, gr. ss–j. *Tinctura Ignatiæ*,—Dose, ♏ij–x.

Physiological Actions. Ignatia closely resembles Nux Vomica in action, a poisonous dose producing similar exaltation of the spinal functions, muscular writhing and tetanic spasms, resulting in death by asphyxia. It especially exalts the susceptibility of the sensory nerves, and those of special sense, for a time; the exaltation being succeeded by an opposite condition, manifested by numbness and torpor, with great mental depression. It causes a feeling of constriction about the throat, and a sensation of intense anguish at the pit of the stomach.

Therapeutics. Ignatia is warmly recommended for—

Hysteria, to control the general hyperæsthesia, insomnia, clavus hystericus, mental excitement or depression, aphonia, diseased appetite, convulsive crying or laughing, etc. (Phillips and Piffard).

Cerebro-spinal Irritability is diminished by small doses, though excited by large ones. Ignatia is the best controller of functional phenomena of the cerebro-spinal axis (Piffard).

Globus Hystericus, may often be removed by Ignatia given in small doses.

*HOANG-NAN.

Hoang-Nan, or Hwang-Nao, is the bark of *Strychnos Gautheriana*, or Tropical Bind-weed, a creeping vine of the nat. order Loganiaceæ, found in the mountains of Tonquin. It contains the alkaloids *Strychnine* and *Brucine*. thus resembling in composition its congeners Nux-Vomica and Ignatia, but differing from them, as they do from each other, in the proportional quantities in which the alkaloids are contained,—Brucine predominating in this plant, as Strychnine does in the other two.

Action and Uses. Like the other members of the Strychnos family, Hoang-Nan is an active tetanizer, its action generally corresponding with that of Nux-Vomica. It was first brought into notice by the missionary fathers stationed in the French colonies in Asia, they having found its employment general among the natives for leprosy and hydrophobia. Along the coast of

Tonquin and Cochin-China, and in Pondicherry, Trinidad, Venezuela, etc., it has an established reputation in the two terrible diseases mentioned, also as a remedy for the bites of venomous serpents and other reptiles, scrofulous and syphilitic ulcers, indolent sores, etc. It has been used successfully for malarial fevers, in lieu of quinine, and is highly spoken of by Father Brosse, as a stimulant to the intellect, without producing any subsequent depression.

The Dose of the powdered drug is about gr. iij–v;—of the aceto-alcoholic Extract, gr. $\frac{1}{8}$–$\frac{1}{2}$;—and of the concentrated Tincture, ♏j–v.

PICROTOXINUM,—Picrotoxin, Fish Poison.

Picrotoxin or *Picrotoxic Acid*, is a neutral principle prepared from the seeds of *Anamirta paniculata*, or Menispermum Cocculus, an Asiatic climbing plant, of the nat. ord. Menispermaceæ, the berries of which are called *Cocculus Indicus*, or Fish-berries. Besides *Picrotoxin*, the active principle, the shells of the seeds contain two other principles, Menispermin and Paramenispermin, which are inert; also Hypopicrotoxic Acid.

Preparations. There are none official, except Picrotoxin itself.

**Extractum Cocculi Fluidum*,—Dose ♏j–iij.
**Tinctura Cocculi* (1 to 8), ♏ij–xv. **Planat's Tincture* (1 to 4), ♏j–v.
Picrotoxinum, gr. $\frac{1}{40}$–$\frac{1}{20}$ in pill by stomach, or gr. $\frac{1}{60}$–$\frac{1}{40}$ hypodermically.

Antagonists. *Chloral* is antagonistic to its cerebral and spinal actions, but synergistic to its depressing power over the heart and respiration. *Acetic Acid* gives relief in overdosing, and may have some antidotal power.

Physiological Actions. Picrotoxin is a cerebro-spinal exaltant, affecting especially the centres in the medulla oblongata, and representing the combined action of Belladonna and Nux-Vomica. It causes muscular twitching, incoordination, stupor, delirium, epileptiform convulsions, tonic and clonic spasms alternating, exalted reflexes, trembling, then coma, insensibility, and death by paralysis of the heart. The drug paralyzes Setschenow's reflex inhibiting centre, and stimulates the reflex centres in the cord. It stimulates all secretions, but especially the intestinal, causes nausea and vomiting, and slows both heart and respiration, after transiently accelerating them.

Cocculus berries are used to adulterate beer, in order to make it more bitter and intoxicant.

Differences between Picrotoxin and Strychnine Spasms. The spasms caused by Picrotoxin are choreic and chiefly affect the flexor muscles;—those from Strychnine are tetanic, affecting principally the extensors.

Therapeutics. Picrotoxin is used chiefly in nervous diseases.

Epilepsy is amenable to it, especially in cases attributable to onanism, in anæmic subjects, and where the attacks are nocturnal in time.

Paralyses, where there is a sense of giddiness, and lightness in the head. It is especially good in paralysis of the sphincters, and in hemiplegia brought on by cold, as facial paralysis, etc.

Chorea is well treated by Picrotoxin, but requires full doses.

Leucorrhœa, when the discharge is sero-purulent, with lumbar pains.

Dysmenorrhœa is often benefited by the Tincture of Cocculus commenced two days before the stated period, and continued throughout it.

Dyspepsia, with severe epigastric pain, and flatulence,—it is efficient.

Flatulent Colic is singularly amenable to the influence of Cocculus.

Vomiting, with giddiness, headache, and intolerance of light and sound,—is frequently arrested by Cocculus, when other remedies fail.

Sweats of Phthisis may be arrested for days by Picrotoxin, gr. $\frac{1}{200}$–$\frac{1}{100}$.

Parasitic Skin Diseases,—Picrotoxin as ointment, gr. x ad ℥j.

Pediculi may be killed by the Ointment, but care should be taken to avoid using it on an abraded surface, lest poisoning result.

ERGOTA,—Ergot of Rye.

Ergota, Ergot of Rye,—the sclerotium (intermediate fibrous stage) of *Claviceps purpurea*, a fungus replacing the grain of *Secale cereàle* (rye), and growing within its flower. Dose, gr. x–xxx.

It contains, according to Kobert (1885), three active principles, *Ergotinic Acid*, affecting the nervous system, heart and respiration;—*Sphacelinic Acid*, which produces gangrenous ergotism, stimulating the vaso-motor system;—and *Cornutine*, an alkaloid, which possesses the ecbolic action, and causes convulsive ergotism. The drug also contains a non-drying Oil, with Trimethylamine, and Lactic and Phosphoric Acids. The composition of Ergot is much disputed; and various names have been given to supposed alkaloids and principles believed to exist in it, as Ergotine, Ergotinine, Ecboline, Sclerotinic Acid, Scleromucin, Sclererythin, Scleroxanthin, etc.

Ustilago Maydis, Corn Ergot,—grown upon *Zea Mays*, the Indian corn or Maize; probably has a similar composition. One of its constituents is a volatile principle named *Secaline*, supposed to be identical with Trimethylamine.

Preparations.

Extractum Ergotæ Fluidum,—Dose ʒss–ij. *Vinum Ergotæ*,—Dose, ʒj–℥j.

Extractum Ergotæ, Ergotin, gr. j–x. **Squibb's Extract of Ergot* is a good preparation and represents the power of the drug. Dose, gr. ¼–v hypodermically, gr. j–x per orem.

The *Ergotin of Bonjean* is very variable and often inert. *Wigger's Ergotin* is insolable in ordinary menstrua, and is inert on the vascular apparatus, but causes enteralgia and gastro-enteritis. *Tanret's Ergotinine* is probably an active alkaloid; its dose is gr. $\frac{1}{30}$–$\frac{1}{10}$.

* *Extractum Ustilaginis Maydis Fluidum,*—Dose, ℥ ss–ij.

Physiological Actions,—are divided into two sets of phenomena, named respectively *Acute* and *Chronic Ergotism*, according as the drug is administered in large doses, or in small quantity for a considerable length of time. Ustilago has properties similar to those of the Ergot of Rye, as far as examined at present.

Acute Ergotism. In large doses Ergot acts as a gastro-intestinal irritant, causing nausea and vomiting, gastralgia, colic, thirst, difficult micturition, and purging. It slows the heart, raises the arterial tension enormously, dilates the pupils, and produces pallor, vertigo and frontal headache. Its action on the circulation is due to its inducing arterial anæmia; but whether this is done by contracting the arterioles through local action on their muscular fibre, or by central stimulation of the vaso-motor system, or by causing venous dilatation, is disputed. It certainly stimulates the contraction of unstriped muscular fibre; especially affecting the sphincters and the uterus, causing continuous labor pains and tonic contraction of the sphincter vesicæ, making micturition difficult, if not impossible. It also produces cerebral and spinal anæmia.

Chronic Ergotism occurs in two forms,—(1) the *Convulsive*, (2) the *Gangrenous*,—either usually excluding the other. The convulsions are tetanoid spasms of the flexor muscles, of the uterus, the muscular fibres of the intestines, and the muscles of respiration, ending in coma and death by asphyxia. The gangrenous form begins with coldness and numbness of the limbs, formication all over the body, loss of sensation and the special senses, bullæ of blood and ichor, followed by dry or moist gangrene of the lower extremities, buttocks and other parts, epileptiform convulsions, coma and death. Autopsy shows changes in the posterior columns of the cord.

Therapeutics. Ergot has a wide field. In—

Conjunctivitis, and inflammations of mucous membranes generally, given internally and applied locally, it proves of striking benefit.

Lax Sphincters of the rectum and bladder are contracted by Ergot.

Acute Dysentery in the congestive stage is well treated by full doses.

Hemorrhoids,—are well treated by Ergot locally, not internally, as it promotes venous congestion when so given.

Hemorrhages of arterial type, not in the passive or venous form.

Cardiac Hypertrophy without valvular lesion,—Ergot to slow the heart.

Aneurism,—Ergot aids coagulation by slowing the blood-current.

Mania due to cerebral hyperæmia,—Ergot is a very useful remedy.

Headache, Migraine, etc., of congestive form,—Ergot acts very well.

Myelitis and Spinal Congestion,—large doses prove very successful.

Cerebro-spinal Meningitis,—Ergot is here one of the very best remedies.

Splenic Enlargement,—Da Costa has found that Ergot administered internally will reduce the size of an enlarged spleen.

Diabetes Insipidus is best treated by Ergot, according to Da Costa, etc.

Amenorrhœa,—when due to plethora, has been frequently cured by Ergot.

Impotence, due to escape of the blood from the dorsal vein of the penis.

Incontinence of Urine,—from paralysis of the sphincter vesicæ.

Uterine Affections, as chronic metritis, subinvolution, fibroids and polypi, congestive dysmenorrhœa, etc.,—Ergot causes firm contraction of the organ, and promotes the absorption of inflammatory products.

Obstetrics. Here Ergot is much used, and often very injuriously. Producing continuous uterine contractions, instead of the natural ones (which are intermittent), it should never be used when there is any obstacle in front of the child. Dangers are—rupture of the uterus, laceration of the perineum, paralysis of the fœtal heart. At the end of the second stage of labor it is well used, to promote uterine contraction and expulsion of the placenta, and to guard against post-partum hemorrhage.

DIGITALIS,—Foxglove.

Source. Digitalis consists of the leaves, collected from plants of the second year's growth, of *Digitalis purpurea*, the Purple Foxglove, a plant of the nat. ord. Scrophulariaceæ, which grows wild in Europe, and is cultivated in this country, often in private gardens for its beautiful spike of purple flowers, and largely by the Shakers for the drug market.

The British Phar. directs that the official drug shall consist of "the dried leaf, collected from the *wild*, indigenous plant, when about two-thirds of the flowers are expanded." Much of the leaf found in our shops, is of very poor quality, a large proportion being inert; but whether this is due to our Phar. not restricting the official drug to the wild plant, or to careless treatment in gathering and drying, is not definitely known. When, however, the leaves are imperfectly dried, a process of decomposition sets in, which destroys the active principles, and may produce new and poisonous ones. A similar decomposition is said to occur whenever the tincture of Digitalis is mixed with watery or syrupy solutions. Certain it is, at any rate, that Digitalis is one of the most unreliable drugs, in respect of the physiological activity of any particular sample or preparation. The seeds are known to contain the active principle in much greater proportion than the leaves, but they are never used.

Composition. The active principle of Digitalis has been designated by the term *Digitalin*, (Digitalinum), under which name a substance was official n the U. S. and Br. Phar. and a process was given therein for its extraction, ntil their last revision, when it was struck from both lists. It was an amorphous product, of complex composition, and did not represent Digitalis.

In 1871 Nativelle received the Orfila prize from the French Academy for the discovery of a crystalline principle in Digitalis, which he named *Digitaline*. This was supposed to be the active principle of the plant, until Roucher, (1872) and Schmiedeberg, (1875), found it to be a complex body, consisting of a mixture of Digitoxin and Digitalin. Schmiedeberg's latest analysis is now accepted as the most accurate determination yet obtained of this vexed question. He enumerates five principles at least as contained in Digitalis, viz.:—(1) *Digitalin*, amorphous, insoluble in water, but readily soluble in alcohol; the active ingredient of Homolle's French Digitaline and the Digitalin of the U. S. and Br. Pharmacopœias;—(2), *Digitoxin*, insoluble in water and sparingly soluble in alcohol; the most active of all, and the principal constituent of Nativelle's prize Digitaline;—(3) *Digitaleïn*, soluble in both water and alcohol;—(4) *Digitonin*, readily soluble in water, sparingly so in alcohol;—active, but acts like *Saponin*, forming a solution which froths easily and antagonizes the other three;—(5) *Digitin*, which seems to be entirely inert. The first three are cardiac poisons, the fourth antagonizes them; and all five are non-nitrogenous, and except Digitoxin, are glucosides.

Preparations vary greatly in results, by reason of the different solubilities and actions of the active principles.

Digitalis, Folia Digitalis, Digitalis Leaves,—Dose, gr. ss–iij.

Abstractum Digitalis, Abstract of Digitalis,—Dose, gr. ¼–ij.

Extractum Digitalis, Extract of Digitalis,—Al. 2, Aq. 1,—Dose, gr. ⅙–½.

Extr. Digitalis Fluidum, Fl. Ext. of Digitalis,—Al. 3, Aq. 1,—Dose, ♏j–iij.

Tinctura Digitalis, Tincture of Digitalis,—15 per cent. Dose, ♏v–ʒj.

Infusum Digitalis, Infusion of Digitalis,—1½ per cent. Dose, ℥ss–j. Is flavored with Cinnamon, and has 7½ per cent. of Alcohol.

**Digitalinum*, Digitalin,—the complex product of the process in the U. S. and Br. Phar., but no longer official. Dose, gr. $\frac{1}{60}$–$\frac{1}{30}$.

Note on the Preparations.—Of the above, the *Tincture* and *Fluid Extract*, being alcoholic preparations, contain a large proportion of Digitalin and Digitaleïn, with a small proportion of Digitonin; the Digitoxin going to the bottom as an insoluble precipitate. The *Infusion* contains a larger proportion of Digitonin than of the others, some Digitaleïn, and little or no Digitoxin or Digitalin. It is the best for diuretic action, the Tincture for acting upon the heart; but to obtain the action of the plant itself, the powdered leaves must be used in pill or capsule.

Antidotes and Antagonists. The chemical antidote is *Tannic Acid*, but as the tannate is not inert, the stomach should be evacuated. *Aconite* is the best antagonist to the effects of large doses, *Opium* to those of its long-continued use. *Saponin* and *Senegin* are considered to be its most complete physiological antagonists.

Physiological Actions. Digitalis is a cardiac tonic and a vascular stimulant, an excito-motor, a paralyzant, an anaphrodisiac, a diuretic, and an emetic.

In overdoses it irritates the mucous membranes, causing sneezing, severe gastric disturbance, nausea, vomiting, colic and purging, the discharges being of a grass-green color. It lowers temperature, probably by lessening the blood-supply to the tissues, produces headache, irregularity of the heart's action, vertigo and an appearance of vibratory fringes of color around objects.

The Heart is slowed by Digitalis, but its force is at the same time increased. The drug stimulates the cardiac motor ganglia, the inhibitory apparatus, and the vaso-motor centres, contracting the arterioles; and thereby greatly raising the arterial tension. Full doses continued exhaust the irritability of the motor ganglia and paralyze the cardiac muscle itself. The recumbent posture must be maintained when Digitalis is given for its full cardiac effects. Its general effect on striped muscular tissue is to lessen the contractile power, causing great weakness and languor. Under it, the excretion of urea is at first increased, but soon decidedly diminished. It lessens the sexual appetite and impairs the venereal function.

The *Diuretic Action* of Digitalis is due to its peculiar influence upon the general and renal circulation, it increasing the force of the ventricular contractions, while at the same time one of its constituents, *Digitalin*, contracts the bloodvessels of the body, and two others, *Digitoxin* and *Digitalein*, dilate the renal arteries. The effect of this combined action is to greatly raise the arterial tension and the blood-pressure in the glomeruli, their efferent vessels being contracted;—while the rapidity of the renal circulation is increased and its volume augmented, by the greater force of the heart-beat and the dilatation of the afferent vessels. No other drug known has this double power, and therefore, so far as vascular action is concerned, Digitalis is the ideal diuretic. Still while its power to produce diuresis in cardiac disease is unquestioned, most observers deny that it has any such power in health.

Lethal Doses lessen the reflexes by stimulation of Setschenow's centre, and paralyze the muscles and the peripheral nerves, motor and sensory. Respiration, at first slowed, becomes rapid and feeble; cyanosis, coma and convulsions follow, and death by sudden paralysis of the heart, which is arrested in systole.

Aconite compared with Digitalis. *Aconite* relaxes the inhibition, but depresses the cardiac motor ganglia;—*Digitalis* increases inhibition, and stimulates the motor apparatus. Both drugs finally paralyze the heart,—Aconite by direct depression, Digitalis by over-stimulation. Both drugs depress the cardiac muscle. Under Aconite, the heart is arrested in diastole,—under Digitalis, in systole. The arterial tension is lowered by Aconite,—raised by Digitalis. Aconite acts quickly,—Digitalis very slowly; a fact which makes the latter drug of little value in poisoning by the former. Both drugs slow the heart, but otherwise antagonize each other in their cardiac actions.

Therapeutics. Digitalis is said by Phillips to be particularly adapted to londes, and persons of sanguine and indolent temperament. Its chief uses in isease are based on its properties as a heart tonic and a diuretic. In—

itral Disease, when the heart is rapid and feeble; it moderates hyperæmia of the lungs, and engorgement of the pulmonary veins, by giving the auricle time to empty itself through the obstructed orifice.

ortic Disease,—Digitalis gives relief when the cardiac muscle fails, and compensatory hypertrophy has not set in. Otherwise it will not.

rritable Heart of soldiers,—Da Costa finds it often curative.

ilated Right Heart,—Digitalis gives miraculous relief.

alpitation, *Cardiac Failure*, *Venous Engorgement*, are all well treated by the Tincture of Digitalis, in medium doses.

imple Hypertrophy, *Pericarditis*, *Fatty Heart*, are conditions in which Digitalis must not be used, except temporarily for special reasons.

ropsy,—both cardiac and renal,—Digitalis is well indicated. The infusion is regarded as the best diuretic, while alcoholic preparations, (tincture, fluid extract), are employed to act on the heart.

neumonia, and other inflammations, in first stage,—it is useful.

carlet Fever, in the early stage, and when the kidneys strike work,—Digitalis, in small doses, is an admirable remedy.

emorrhage from a large surface, and in the hemorrhagic diathesis.

ongestive Headache, *Hemicrania*, *etc.*,—it raises the vascular tone.

ania, *Delirium Tremens*, and other congestive mental conditions.

xophthalmic Goitre,—Digitalis is an excellent remedy.

evers. In Germany this drug has been much used as an antipyretic, especially by Wunderlich and Liebermeister. The latter, however, has lately advised against the practice.

umulative Action of Digitalis. During a course of this drug sudden alarming symptoms may arise, due to exhaustion of the cardiac motor ganglia. They may be prevented by strictly maintaining the recumbent posture, and stopping the remedy for a few days in every two weeks. This cumulative action has been denied lately by many authorities.

* STROPHANTHUS.

Source and Composition. The seeds of *Strophanthus hispidus*, an frican climbing plant, (nat. ord. Apocynaceæ), from which the natives extract toxic preparation known as the Kombé arrow-poison. It contains a crys-lline glucoside, named *Strophanthin*, the active principle, which is bitter, ightly acid, soluble in water and in alcohol, but almost insoluble in ether, hloroform, benzin, etc. It is very plentiful in the seeds, (8 to 10 per cent.), and is an agent of great energy, the frog being killed by a solution of 1 in 10,000,000. (Denian).

Preparations. Professor Frazer recommends the tincture.

* *Tinctura Strophanthi*, (1 in 20),—Dose, ♏ v–x, or ♏ ½–ij frequently repeated. A stronger tincture, (1 in 8), is on the market.

* *Strophanthinum*, Strophanthin,—Dose, gr. $\frac{1}{120}$–$\frac{1}{60}$ hypodermically. gr. $\frac{1}{11}$ has been used, the influence of the one injection upon the circulation lasting at least 8 days.

Physiological Action. Strophanthus acts primarily upon muscular tissue, by direct contact through the blood, and with great energy. It increases the contractile power of all striped muscle, and in poisonous quantity it fixes the muscular contraction into a condition of tetanic permanence, the muscle being unable to resume its normal condition of partial flexibility. As the heart receives much more blood in a given time than any other muscle in the body, it is quickly and markedly affected by the strophanthus-charged fluid, and by regulating the dosage, the cardiac muscle may alone be affected, by a quantity which would not influence the other muscles.

Small doses stimulate the cardiac contractions, increasing the force of the ventricular systole, and lowering the rate of the heart-beats. At the same time the general blood-pressure is raised, and diuresis produced, both being due to the *vis a tergo*,—the direct stimulation of the circulation from behind. Large doses paralyze the heart in systole, and leave the cardiac muscle in a state of contraction resembling cadaveric rigidity. It does not act through the nervous system, but paralyzes muscular tissue, striated and non-striated, by direct contact;—and when contractility has been once destroyed thereby, no stimulus will re-excite it. It does not affect the vascular system directly.

Compared with Digitalis, then, we have in Strophanthus a much more powerful cardiac stimulant, differing from Digitalis in not producing any vaso-motor constriction of the arterioles. It reduces the pulse, lowers body-temperature somewhat, is not cumulative in action, and does not cause any gastro-intestinal disturbance. It is diuretic, by direct stimulation of the renal circulation; and has power over rigors, by its rapid cardiac action, stopping them and preventing their recurrence.

Therapeutics. Strophanthus is the most valuable of the cardiac stimulants, from the rapidity and permanence of its action, as well as its non-interference with the calibre of the peripheral vessels. It relieves cardiac dyspnoea in a few minutes, in less than an hour it modifies the pulse-rate, and the influence of a single dose upon the circulation persists for a very long time. It is certain to replace Digitalis in the treatment of chronic Bright's disease valvular lesions of the heart, where it is important that the work of the heart should not be increased by any additional resistance in the arterial system.

Strophanthus has been exceedingly useful in the treatment of—

Bright's Disease,—for the dyspnœa, orthopnœa, dropsy and uræmia.
Mitral Insufficiency,—with great anasarca and dyspnœa.
Palpitation, exaggerated cardiac action, and in weak heart.
Exophthalmos,—with tumultuous action of the heart.
Pulmonary Œdema,—due to valvular lesions, or to pneumonia.
Endocarditis, Acute,—also in atheroma of the arteries.
Reflex Palpitation of neurasthenia, hysteria and chlorosis.
Rigors due to catheterization, or operations on the urethra.

CIMICIFUGA,—Black Snake-root.

Source and Composition. The root of *Cimicifuga racemosa*, or *Actea racemosa*, an indigenous plant of the nat. ord. Ranunculaceæ. It contains a Volatile Oil, two Resins, Tannic Acid, etc. The active principle has not been isolated.

Preparations. They must be made from the fresh root.

Extractum Cimicifugæ Fluidum, ♏v–xxx. *Tinctura Cimicifugæ*, ♏xv–ʒj.
* *Macrotin* is an impure resin precipitated by water from a concentrated alcoholic preparation. Dose, gr. ss–ij.

Physiological Actions. Cimicifuga is anti-spasmodic, aphrodisiac, diaphoretic, diuretic, and expectorant. It acts similarly to Digitalis on the heart and circulation, and similarly to Ergot on unstriped muscular fibre, but is much feebler in activity than either. Its taste is bitter and nauseous, resembling that of Opium.

Small Doses stimulate digestion and secretion, especially the secretions of the bronchial mucous membrane and the kidneys. It also stimulates the generative function and the menstrual flow.

Full Doses slow the heart rate while increasing its force, raise arterial tension, and stimulate uterine contraction. In large doses it dilates the pupils, and causes dim vision, vertigo, intense headache, nausea, vomiting, and in some persons sopor.

Therapeutics. Cimicifuga is safer than Digitalis, and should be more frequently used where the latter drug is indicated. In—

Cardiac Diseases, it is used very efficiently, especially in weak or fatty heart, where Digitalis would be dangerous.
Chorea, about the age of puberty,—Cimicifuga is very successful.
Puerperal Hypochondriasis has been completely removed by it.

Bronchitis, acute and chronic,—it is valuable as an expectorant.

Rheumatism, of the localized muscular variety,—as lumbago, torticollis, pleurodynia, intercostal rheumatism,—are remarkably benefited by Cimicifuga, which has a strong affinity for the muscles.

Neuralgia of various kinds, especially ovarian, also in neuralgic and congestive dysmenorrhœa, it is very efficient.

Uterine Disorders, as subinvolution, in which it may be given with Ergot.

Delirium Tremens,—in which Cimicifúga is an excellent nerve-tonic.

Impotence, of functional character,—it is a remarkably efficient remedy.

In Obstetrics,—to initiate uterine contraction, to allay after-pains and nervousness after delivery, and to check hemorrhage.

* CONVALLARIA,—Lily of the Valley.

Source and Composition. Convallaria Majalis, the "Lily of the Valley" is a well-known perennial of the nat. ord. Labiatæ. It contains two ac glucosides, viz.,—*Convallamarin*, the cardiac-acting principle, soluble in b alcohol and water;—and *Convallarin*, an emeto-cathartic, soluble in alcoh but insoluble in water;—also an acrid *Resin*, which acts similarly to the la principle.

Preparations are made from the whole plant.

* *Extractum Convallariæ*, Extract of Convallaria,—a black solid, freely s ble in water and in alcohol. Dose, gr. ij–x.

* *Extractum Convallariæ Fluidum*, Fluid Extract of Convallaria,—an a holic preparation of the whole plant, containing Convallarin. Dose, ♏j

* *Infusum Convallariæ*, Infusion of Convallaria,—contains no Convallari being insoluble in water. Dose, ℥ss–ij.

* *Convallamarinum*, Convallamarin,—amorphous, white, bitter powder, sol in water and in alcohol, but not in ether. Dose, gr. ss–ij.

Physiological Action. Convallaria acts similarly to Squill and Digi being a gastro-intestinal irritant, a cardiac stimulant and a diuretic. medicinal doses it slows and strengthens the contractions of the heart, r arterial tension, slows and deepens the respiration, and increases the u discharge. Lethal doses cause irregular cardiac action, with rapid and f pulsations;—also extreme slowing of the respiration, greatly lowered b pressure, and finally arrest of the heart in systole, by direct stimulation inhibitory apparatus. Preparations of the root, and alcoholic preparatio the whole plant, are liable to excite emeto-catharsis, which is due to the and the Convallarin. The powdered root is sternutatory.

Therapeutics. Long known as an efficient cathartic and diuretic, C laria has recently come into prominence as a cardiac tonic, being considered safer than Digitalis, as it has no cumulative action, and does not disturb the stomach or the cerebro-spinal functions, if preparations devoid of Convallarin be used. It has been exceedingly well administered in many forms of heart-disease, particularly in—

Mitral Stenosis or Insufficiency, characterized by arythmia, pulmonary congestion, dyspnœa, etc.

Dropsy from cardiac disease,—it is very efficient.

Fibroid Phthisis,—it has given thorough satisfaction.

Cardiac Asthma,—with Potassium Iodide it is one of the most efficient methods of treatment.

Aortic Regurgitation,—it relieves many of the most distressing symptoms.

Valvular Affections of the Heart, generally, when accompanied by dropsy and weak cardiac action.

SCOPARIUS,—Broom.

Source and Composition. The tops of *Sarothamnus Scoparius*, the common "Broom," a well-known garden shrub of the nat. ord. Leguminosæ. It contains a neutral, crystalline principle, named *Scoparin*,—and a liquid, volatile, poisonous alkaloid, *Sparteine*, which contains no oxygen, but has decided basic qualities.

Preparations. There are none official.

**Decoctum Scoparii*, Decoction of Broom (B. P.), ℥j to the pint,—Dose, ℥j–iij, every 3 or 4 hours, until diuresis occurs.

**Sparteinæ Sulphas*, Sulphate of Sparteine,—Dose, gr. $\frac{1}{16}$–$\frac{1}{2}$, hypodermically;—gr. ½–ij per orem. Small doses, gr. $\frac{1}{16}$–$\frac{1}{4}$, every 5 hours, for cardiac action;—larger, gr. j–ij, for diuresis. (Clarke). Larger doses are necessary, say gr. jss–iij, ter die. (Prior).

Physiological Action. Broom-tops are diuretic and laxative, also emetic and cathartic in large doses. In the form of decoction they have long been a favorite diuretic and vehicle for other diuretics, in the treatment of dropsies both cardiac and renal, but are considered most reliable in the dropsy of renal origin.

Sparteine has been thought to resemble Coniine in its action, paralyzing the end-organs of the motor nerves and vagi, lowering the reflex excitability of the cord, and causing death by paralyzing the respiratory centre in the medulla. Recent observations, however, place it in the Digitalis group, and in the front rank among the members thereof.

In small doses Sparteine slows and strengthens the heart-beats, and raises arterial tension, at the same time increasing the cutaneous and renal circulation, so that the surface becomes flushed and moist, and in some cases marked diuresis and diaphoresis occur. The respiration, at first quickened, is soon slowed and deepened,—the patient having a sense of increased warmth and well-being, and if suffering from irregular cardiac action, præcordial distress and dyspnœa, these symptoms are promptly relieved. If the pulse has been abnormally slow Sparteine will quicken it, though its general action is to slow the cardiac rate. An overdose brings on marked palpitation, a small and rapid pulse of very high tension, præcordial pain and a sense of "tightness" about the chest, with anxiety, and a feeling of intense debility, perhaps even muscular tremor. Death occurs by asphyxia from depression of both the centre and the muscles of respiration.

The action of Sparteine upon the circulation is manifested quickly as com pared with that of other similarly-acting drugs. In ½ hour after its inges tion the pulse is markedly slower,—in another ½ hour the arterial te sion rises, and both effects last from 5 to 6 hours. When taken regularly f several days or weeks its influence remains for nearly a week after its disc tinuance. There is, however, no danger of cumulative action, and thoug the dosage employed has varied from gr. $\frac{1}{16}$ every 4 hours, to gr. xij in hours, no toxic action was observed, nor was there any evidence of accum tion, even when given continuously for 3 to 4 months. (Clarke). Only i a dose of gr. xxxj were evil effects observed. (Prior).

Its diuretic power on healthy persons is denied by some observers and affirm by others, though all acknowledge it in disease. It is accompanied by incre excretion of urea,—is due to the increase of blood-pressure both behind in front of the renal circulation,—and is produced only by large d gr. ½–gr. ij.

Sparteine acts directly on the cardiac muscle, as well as upon the inhibi apparatus, thus giving greater force to the cardiac contractions, and reg ing (generally slowing) the pulse-rate. It also stimulates the vaso- centre to contract the vessels throughout the splanchnic area, thus incre the circulation in the skin and kidneys, and raising arterial tension gene

Therapeutics. Sparteine has been employed with very great bene cardiac affections requiring stimulation of the heart's action with the sm possible increase of arterial tension, relief of dyspnœa, præcordial pain, p tation and œdema. In such cases small doses, gr. $\frac{1}{16}$–$\frac{1}{4}$ are best, and a influence of the drug is remarkably sustained, they need not be rep oftener than once in 5 or 6 hours. It has given the most marked satisf in—

Mitral Regurgitation, in which it relieves all the symptoms.

Mitral Stenosis, when the pulse is small, weak and irregular.

Aortic Regurgitation,—it quiets excited action of the heart, without unduly prolonging the systole, and is of great value.

Chronic Bright's Disease, with hypertrophy and high arterial tension,—it stimulates the heart without increasing the tension.

Exophthalmos,—it gives remarkable relief to all the symptoms.

Palpitation and Arhythmia,—small doses are of great service.

Asthma,—it is of signal benefit, cutting short the paroxysms, and rendering their recurrence much less frequent.

Opium-habit,—it is used at period of depression during the treatment, to overcome the "plateau" shown in the sphygmograph trace, by stimulating the cardiac action. (Jennings). For this purpose, doses of gr. jss–iij three or four times daily are necessary. (Prior).

SCILLA,—Squill.

Source and Composition. Squill is the sliced bulb of *Urginea Scilla*, or *Scilla maritima*, a perennial plant of the nat. ord. Liliaceæ, growing along the shores of the Mediterranean. Its active principle is probably the acrid, bitter glucoside, *Scillitoxin* or *Scillaïn*, which it contains, along with Scillipicrin, Scillitin, Scillin, Sinistrin, etc. Dose of the dried bulb, in powder, gr. j–iij.

Preparations. The Compound Syrup contains Tartar Emetic.

Extractum Scillæ Fluidum, Fluid Extract of Squill,—Dose, ♏j–iij.

Tinctura Scillæ, Tincture of Squill, 15 per cent.,—Dose, ♏v–xxx.

Acetum Scillæ, Vinegar of Squill, 10 per cent.,—Dose, ♏x–ʒj.

Syrúpus Scillæ, Syrup of Squill,—has of the Acetum 40 parts, with Sugar 60, and Water. Dose, ʒss–ij.

Syrúpus Scillæ Compositus, Compound Syrup of Squill, Cox's Hive Mixture,—has Squill, Senega, Calcium Phosphate, etc., and Tartar Emetic, the latter in the proportion of about gr. ¾ to the ℥. Dose, ♏v–x, for children; ♏x–xxx for adults;—as an emetic ʒj–ij, according to age.

Physiological Action. In small doses Squill is expectorant, in large ones it is emetic and diuretic, and in overdoses it is an irritant poison, causing nausea and vomiting, purging, gastro-enteritis, strangury, bloody urine, perhaps suppression, convulsions, and death by paralysis of the heart in systole. In medicinal doses it acts upon the circulation like Digitalis, slowing and strengthening the cardiac contractions, making the pulse slower and stronger, raising arterial tension, and increasing the flow of urine. The difference between its actions as an expectorant and a cardiac stimulant would seem to indicate its possession of two or more active principles, one specifically affecting the secretory mucous membranes, and the other the circulatory apparatus.

Therapeutics. Squill is a household word in many countries, especially in England, where it is freely used in domestic practice for coughs of infants and children, and causes many deaths by direct poisoning. It is chiefly employed as an expectorant and diuretic, though it renders excellent service as a cardiac stimulant. It is well used in—

Bronchitis,—when the secretion, though profuse, is difficult to expel. If secretion be scanty, first give Ipecac.

Chronic Bronchitis,—the Pil. Ipecac cum Scillâ of the B. P., gr. x night and morning, is a most useful remedy.

Dropsy, of cardiac origin, Squill combined with Digitalis, etc., is an efficient diuretic.

Croup, the Compound Syrup, remembering its Tartar Emetic and the liability of depression therefrom.

Whooping-cough, and other irritant coughs,—the Acetum or Syrup.

Cardiac Disorders,—as a stimulant to the heart, in cases where Digitalis would be considered dangerous.

BELLADONNA,—Deadly Nightshade.

Source and Composition. The leaves and root of *Atropa Belladonn* a European plant of the order Solanaceæ. It contains two alkaloids,—*A* *pine*, the active principle, and *Belladonnine*,—also a coloring matter nam *Atrosin*, and *Malic Acid*.

Derivatives of Atropine. It is resolvable into *Tropin* and *Tropic A* and may be made synthetically.

Tropeius is the result of treating Tropin with a mineral acid.

Homotropine is obtained by the action of dilute HCl Acid upon the Am dalate of Tropin, and is used by ophthalmologists as Hydrobromat Homotropine. H. slows the heart—Atropine quickens it.

Preparations. Those in the first column are of the leaves, those in second are of the root.

Tinctura Belladonnæ, ♏j–ʒss.	*Abstractum Belladonnæ*, gr. ¼
Extr. Belladonnæ Alcohol., gr. ¼–½.	*Extr. Belladonnæ Fluid.*, ♏j–

Atropinæ Sulphas, gr. $\frac{1}{100}$–$\frac{1}{60}$. Hypodermically, give ♏ij–iv of a solu having gr. j ad ℥j, each minim equalling gr. $\frac{1}{480}$.

The Ointment, Plaster and Suppositories of Belladonna are also much us

Antidotes and Antagonists. In poisoning *Tannic Acid* and em should be used. *Opium* is the physiological antagonist (?) for its effec the cerebrum, pupil, heart, respiration, arterial tension, and kidneys. Physostigmine, Aconite, Pilocarpine and Quinine are each antagonistic to some of its effects; Muscarine to most of them.

Physiological Actions. Belladonna is an irritant narcotic, a mydriatic, an anti-spasmodic, an anodyne; in small doses a cardiac, respiratory and spinal stimulant, in large doses a paralyzer of the secretory and motor nerve endings, and a stimulator of the entire sympathetic system. It produces dryness of the mucous membranes of the throat, mouth, nose and larynx; and at first lessens the gastric and intestinal secretions, but soon reproduces them in large quantity.

The Heart-rate is at first slowed, but soon becomes very rapid and vigorous, the pulse being doubled in rapidity; the arterial tension being at the same time raised, the circulation is greatly increased. This the drug accomplishes by stimulating the cardiac sympathetic, and paralyzing the intra-cardiac inhibitory ganglia, thus stimulating the accelerator apparatus while lessening inhibition. [Digitalis increases both.] The vaso-motor ganglia all over the body are stimulated, but afterwards paralyzed by over-stimulation, the heart weakens, the vessels relax, and the blood-pressure is greatly lowered. Complete motor paralysis follows, then delirium, stupor, and finally death, usually by asphyxia.

The Pupils are dilated by the local or systemic use of the drug, by stimulation of the end organs of the sympathetic, and paralysis of those of the motor oculi, thus increasing the power of the radiating iris fibres, and lessening the action of the circular fibres. Atropine also paralyzes accommodation, and lessens the intra-ocular pressure. The least quantity of Atropine affecting the pupil is stated at gr. $\frac{1}{10000}$ (Wood), gr. $\frac{1}{20000}$ (Roosa), gr. $\frac{1}{40000}$ (Ely), gr. $\frac{1}{128000}$ (Trousseau), gr. $\frac{1}{480000}$ (Loring), gr. $\frac{1}{700000}$ (Donders).

The Brain is congested by Belladonna, a busy delirium being produced, and hallucinations with mental disorder, due to a selective action on the cells of the gray matter.

The Spinal Cord is stimulated from the 2d cervical vertebra to the 10th dorsal, resulting in paralysis of the motor nerves, central and peripheral; power being lost in the lower extremities first. Sensation is slightly impaired, but the muscular irritability is not. Respiration is increased, and the temperature raised. By the increased circulation metamorphosis is greatly promoted.

A Diffused Eruption of a scarlet color, greatly resembling that of scarlet fever, is often produced by Belladonna on the skin and fauces, with dysphagia and sore throat, and is sometimes followed by desquamation. It is due to capillary congestion caused by the greatly increased circulation.

Diffused rapidly, Belladonna is also quickly eliminated, particularly by the kidneys. The urine of an animal under the action of Atropine will dilate the pupil of another animal. Herbivorous animals and birds are scarcely susceptible to the action of Belladonna, and pigeons are not affected by it at all.

Therapeutics. Belladonna is especially useful in—

Pain of inflammation,—particularly that of gout, rheumatism, neuralgia due to peripheral disturbance, sciatica, cancer, and pelvic affections.

Cerebral and Spinal Hyperæmia, congestive headaches, encephalitis, meningitis and myelitis,—it proves one of the very best remedies.

Erysipelas of superficial and non-vesicular character, and when cerebral,—Belladonna is really curative in 5 ♏ doses every hour, also the extract locally applied.

Inflammation of the lungs, iris, bladder, kidneys and breasts, are all amenable to Belladonna applied locally or used hypodermically.

Constipation due to atony of the bowels, it is remarkably efficient. The Tincture combined with Nux Vomica and Physostigma Tinctures equal parts of each, of which give 15-drop doses at night.

Enuresis of children,—large doses (gtt. x–xx of Tinct. ter die).

Cystitis, recent, from chill,—the tincture internally, and the Extract applied the perineum.

Spasm of the urethra, bladder, anal sphincter, etc.,—is overcome by it.

Ulcers of the rectum, anal fissures, etc.,—are soothed and healed by the of the Extract locally.

Ptyalism from Mercury, pregnancy, etc.,—is arrested by Atropine.

Abscesses, boils, carbuncles, and other superficial inflammations, are remarkab benefited by Belladonna with Morphine, used locally.

Typhus and Typhoid in their early stages,—Belladonna is very useful.

Acute Nasal Catarrh, with profuse watery discharge,—it is very efficient.

Sore Throat, with fever, inflammation, redness, and swollen tonsils.

Scarlet Fever. Belladonna is said to be prophylactic (?). It relieves m of the symptoms of this disease, and is well used when the rash is imperf the pulse feeble, and the condition adynamic.

Skin Diseases,—notably erythema, eczema, herpes zoster and prurigo.

Sweats of Phthisis,—gr. $\frac{1}{60}$ of Atropine is generally effective.

Asthma and Pertussis are well treated by Belladonna in full doses.

Cardiac Failure when sudden,—Atropine as a cardiac stimulant.

Convulsions, epileptic and puerperal, are often relieved by Belladonna.

Spermatorrhœa and seminal losses are best treated by this remedy.

Poisoning by Opium, Physostigma and Prussic Acid. In Opium poisoning unsuccessful cases treated by Atropine are due to overdosing therewith It should be given in very small doses, and for effect.

Ophthalmologists use Atropine to paralyze accommodation, dilate the p contract the vessels, lessen pain, and diminish intra-ocular tension.

* DUBOISIA.

Source and Composition. The leaves of *Duboisia myoporoides*, an Australian tree of the order Solanaceæ. It contains an alkaloid, *Duboisine*, which is apparently identical with Atropine, Hyoscyamine, etc.

Preparations. There are none official.

**Extractum Duboisiæ*, gr. $\frac{1}{6}$–$\frac{1}{4}$. * *Tinctura Duboisiæ*, gtt. v–xx.
**Duboisinæ Sulphas*, Sulphate of Duboisine (Langenberg's), gr. $\frac{1}{100}$–$\frac{1}{60}$.

Physiological Actions. They are in every respect similar to those of its congener, Belladonna, except that the alkaloid Duboisine is more soluble in water than Atropine, is less irritating to mucous membranes, and more prompt in mydriatic action, but its effects are of shorter duration. It is also less of a cerebral excitant, and more of a calmative and hypnotic. Ringer says that on man its action is more powerful than that of Atropine, but less powerful on frogs.

Therapeutics. Duboisine has hitherto been used only by ophthalmologists, as a mild substitute for Atropine, though it may be used instead of the latter in many conditions, especially the night-sweats of phthisis, respiratory neuroses, and cardiac failure. In—

Mania, puerperal and other forms,—Duboisia is of remarkable value, though at first it rather increases the maniacal excitement.

STRAMONIUM,—Thorn Apple.

Source and Composition. The leaves and seeds of *Datura Stramonium*, a bushy, indigenous herb, also of the order Solanaceæ. It contains an alkaloid, *Daturine*, probably identical with Atropine, also Malic Acid, etc.

Preparations.

Extr. Stramonii (*Foliorum*), gr. ⅙–j. *Extr. Stramonii Fl.*, ♏ j–v.
Tinctura Stramonii, ♏ v–ʒ ss. *Unguentum Stramonii*, 1–4 of lard.

Physiological Actions. They are similar to the actions of Belladonna in almost every particular; but Stramonium is more powerful, and acts chiefly on the sympathetic system, not affecting the motor or sensory nerves. It excites a greater degree of cardiac irregularity, and a more furious delirium; and seems to have a special affinity for the generative apparatus.

Therapeutics. Stramonium is chiefly used to relieve pain. In—

Dysmenorrhœa and Neuralgia,—it is combined with Opium and Hyoscy.

Spasmodic Affections, as asthma, laryngeal cough, hepatic colic, etc.

Asthma,—the leaves are smoked to advantage at the commencement of a paroxysm, the smoke being drawn into the lungs.

Mania of furious character, especially the puerperal form, with suicidal tendency,—Stramonium is highly serviceable, in 10–20 ♏ doses of the tincture every three or four hours, until relief is obtained.

Nymphomania, with great mental depression,—it is very useful.

Chorea and Stammering,—Stramonium is a good remedy.

Ulcers of irritable character,—the Ointment is much used.

Tic Douloureux and Sciatica,—it is often efficient.

HYOSCYAMUS,—Henbane.

Source and Composition. The leaves of *Hyoscyamus niger*, a biennial plant, also of the order Solanaceæ. Its alkaloid, *Hyoscyamine*, is probably identical with Atropine, Daturine and Duboisine; from it is derived *Hyoscine*, a liquid alkaloid yielding Tropic Acid and Pseudotropine.

Preparations.

Extr. Hyoscyami Alcohol., gr. $\frac{1}{4}$–j. *Abstractum Hyoscyami*, gr. $\frac{1}{8}$–j.

Tinctura Hyoscyami, ʒss–℥j:—as a hypnotic, ʒij–℥j is necessary.

Hyoscyaminæ Sulphas, gr. $\frac{1}{40}$–j, varies greatly in purity.

* *Hyoscinæ Hydrobromas*, Hydrobromate of Hyoscine,—Dose, as a hypnotic, gr. $\frac{1}{100}$–$\frac{1}{50}$, by mouth;—gr. $\frac{1}{60}$ will generally be required.

Incompatible most frequently Prescribed with Hyoscyamus is Liquor Potassæ. All the fixed caustic alkalies destroy its alkaloid, as well as those of the allied plants.

Physiological Actions. The action of Hyoscyamine is similar to that of Atropine, Duboisine and Daturine, except that it is the least powerful and least irritant of the group, and the most calmative and hypnotic. It is more stimulant to the vaso-motor system and the cardiac accelerator apparatus than is Daturine, but is less active upon the pneumogastric. Its delirium is never furious and is without hyperæmia, but is accompanied by insomnia. *Hyoscine* is still less active and less irritant, is decidedly anodyne and hypnotic, and very depressant to the respiration.

Therapeutics. Hyoscyamus is principally used as a hypnotic and anodyne when Opium is contraindicated. In—

Acute Mania with high motor excitement, obstinate insomnia and varied hallucinations,—it is by far the best agent to use.

Chronic Mania has been benefited by it more than by any other drug.

Insanity marked by frequent delusions,—it is very efficient.

Delirium Tremens, and the delirium of fevers,—it is an excellent hypnotic, but needs to be used in larger doses than are generally employed.

Monomania of hypochondriacs, is alleviated and often cured by it.

Neuralgias have been much benefited by Hyoscine hypodermically.

Nervous Coughs, Whooping Cough, especially a dry, tickling night cough,—are greatly alleviated by Hyoscyamus.

Locomotor Ataxia, Hyoscyamine for the pains and incoördination.

Paralysis Agitans, mercurial tremor, etc.,—it palliates the trembling.

Colic of various forms,—Hyoscyamus has long been used.

Constipation. Purgatives are rendered more efficient and less drastic by combination with the Extract of Hyoscyamus

CEREBRAL EXCITANTS.

CAMPHORA,—Camphor.

Camphor is a concrete, volatile, waxy solid, obtained from the volatile oil of *Cinnamomum Camphora* (Camphora officinarum), a tree indigenous in China, Japan, Borneo, Formosa, etc. It is slightly soluble in water (1 to 1300), but freely so in Alcohol, Ether, Chloroform, Carbon Bi-sulphide, Oils and Milk.

Derivatives. *Camphor-cymol* is obtained by its distillation with Zinc Chloride;—*Camphoric and CamphreticAcids* result respectively from its lesser or greater oxidation.

Preparations.

Aqua Cámphoræ, Camphor Water,—strength, 8 in 1000, with 16 parts of Alcohol to aid in the suspension of the Camphor. Dose, ʒj–iv.

Spiritus Cámphoræ, strength, 10 per cent. Dose, ♏v–xx.

Linimentum Cámphoræ,—has 1 of Camphor to 3 of Cotton-seed Oil.

Linimentum Saponis. Soap, Camphor, Ol. Rosmarini, Alcohol, Water.

Cámphora Monobromata, Monobromated Camphor,—gr. j–x, in emulsion.

**Rubini's Tincture* is a saturated solution in Alcohol;—Dose, gtt. iv–xx

**Raspail's "Eau Sedatif"* is used externally, and consists of Ammonia, Salt, Camphor, Water, and Alcohol. See page 68.

Physiological Actions. Camphor is antispasmodic, anodyne, antiseptic, diaphoretic, a stimulant expectorant, a cerebral excitant, a gastro-intestinal rritant, and a counter-irritant. It has an acrid, hot taste; irritates the skin and mucous membranes, in quantity exciting severe gastric inflammation, with all the effects of an irritant poison.

In Medicinal Doses it stimulates the vaso-motor system and the cardiac notor ganglia, and lessens the influence of the pneumogastric; thus increasing he circulation and raising the arterial tension. It also stimulates respiration and mental activity, even producing intoxication; promotes perspiration, allays pain, and increases the menstrual flow and the sexual appetite; but its continued use depresses the generative function. "Camphora per nares castrat odore mares."

Large Doses depress the heart and lower arterial tension and diminish the reflex functions of the cord, producing coldness of the surface, insensibility, coma, convulsions and perhaps death.

Elimination takes place by the bronchial mucous membrane, skin and kidneys. Camphor has often caused dysuria.

Therapeutics. Camphor was much used by the older physicians, and is yet greatly valued in China and Japan. It has a reputation for very uncertain action. It is, however, much employed in—

Cholera and choleraic diarrhœa;—allaying intestinal pain and cramp, checking intestinal secretion, and restoring warmth to the extremities.

Summer Diarrhœa, from nervous exhaustion and irritability,—a few doses of the Spirit will often check this complaint promptly.

Infantile Diarrhœa,—the Spirit, in milk, is an effective remedy, especially when the flux is induced by nervous irritation.

Vomiting and Gastralgia,—Camphor has long been effectively employed.

Cardiac Depression,—it acts promptly as a cardiac stimulant.

Nervousness, nervous headache, restlessness, delirium tremens, hypochondriasis, hysterical convulsions, etc.,—as a sedative and antispasmodic.

Nymphomania, Erotomania, etc.,—it is an excellent palliative.

Whooping-cough, cough from habit, and the sympathetic cough of mothers,—the monobromide in 5-grain doses, with Syrup of Tolu and Mucilage.

Capillary Bronchitis with depression,—as a stimulant and expectorant.

Fevers, typhoid and the exanthemata,—small doses in milk frequently used are of great value to promote sleep, quiet the reflexes, and antagonize the cardiac depression.

Dysmenorrhœa and After-pains are much relieved by 10-grain doses.

Chordee and Strangury are relieved by drachm doses of the Spirit.

Toothache,—Camphor and Morphine in a flaxseed poultice, to the cheek.

Gangrene,—the Spirit internally and the powder locally to the surface.

Myalgia, Lumbago, etc.,—the Liniment is effectively palliative.

Catarrhal Colds are readily broken up by Camphor if used in the incipiency internally and by olfaction. Beard's Cold Powder is made by dissolving 5 parts in Ether to a thick consistence, then adding Ammonium Carbonate 4 parts, and Opium 1 part. Dose, gr. iij–x.

ASAFŒTIDA,—Asafetida.

Source and Composition. A fetid gum-resin which exudes from incisions made in the living root of *Ferula Narthex* and *Ferula Scorodosma*, Afghan plants of the nat. ord. Umbelliferæ. Its principal constituent is a Sulphuretted Volatile Oil, which chiefly consists of *Allyl Sulphide*. It also contains a Gum and a Resin, with Feruliac, Malic, Acetic, Formic and Valerianic Acids.

Preparations.

Tinctura Asafœtidæ,—strength 20 per cent.,—Dose ʒ ss–ij.
Mistura Asafœtidæ, Lac Asafetida, Milk of Asafetida, ℥ ss–ij.
Pilulæ Asafœtidæ, 1–4 pills. *Pilulæ Aloës et Asafœtidæ*, 1–4 pills.
Pilulæ Galbani Compositæ, 1–4 pills. Asafetida, Galbanum and Myrrh.
Emplastrum Asafœtidæ.

Physiological Actions. Asafetida is a powerful antispasmodic, a nerve and cerebral stimulant, a stimulating expectorant; as well as tonic, laxative, diuretic, diaphoretic, emmenagogue, aphrodisiac and anthelmintic. Its taste and odor are very nauseous and persistent.

Small Doses Continued are said to cause impaired digestion, alliaceous eructations, acridity in the fauces, gastralgia, flatulent distention, fetid flatus, burning urination, diarrhœa and tenesmus. *Full Doses* produce various phenomena of nervous or hysterical type.

It stimulates the circulation by raising the arterial tension, increasing the power of the cardiac motor ganglia, and relaxing the inhibition. It also stimulates the brain, even to a very pleasant intoxication, and produces a subjective sensation of warmth without any rise of the body temperature. It stimulates the secretions and excretions, the general nervous system, the menstrual flow and the sexual appetite. In Asia it is used as a condiment with food, and though extremely nauseous at first to most people, a taste for it may be readily acquired.

Therapeutics. The disgust which most every one feels for this remedy makes its use very restricted. It is a valuable remedy in—

Flatulent Colic of infants,—the Mistura in teaspoonful doses.

Infantile Convulsions,—the Mistura as an enema is extremely useful.

Hysteria and Hypochondriasis, with indigestion and flatulence,—there is no better remedy to fulfill all the indications present.

Constipation, and amenorrhœa, in anæmic subjects, with ovarian and intestinal torpor,—the Pill of Aloës and Asafetida.

Bronchial Affections, cough of habit, etc.,—there is no better remedy.

Chronic Catarrhs, with cough and dyspnœa,—combined with the Chloride of Ammonium it makes a very useful remedy.

AMMONIACUM,—Ammoniac.

Source and Composition. Ammoniac is a gum-resinous exudation from *Dorema Ammoniacum*, a Persian plant of the nat. ord. Umbelliferæ. It contains a Volatile Oil (not sulphuretted), a Gum and a Resin. Dose, gr. x–xxx.

Preparations.

Emplastrum Ammoniaci cum Hydrargyro,—Ammoniac 72 per cent. Mercury 18 per cent., with Lead-plaster, Sulphur, Olive Oil, etc.

Mistura Ammoniaci, Ammoniac Mixture,—Dose, ℥ss–j.

Emplastrum Ammoniaci.

Physiological Actions,—are similar to those of Asafetida, but much less powerful. It is a stimulating expectorant, a laxative, and has a mild irritant action on the skin.

Therapeutics. Ammoniac is not much used. In—

Chronic Bronchial Affections, especially of the aged,—the Mistura, with the Chloride or Carbonate of Ammonium, is extremely useful, facilitating expectoration and lessening wheezing.

Asthma, spasmodic and hysterical,—it is highly useful, if combined with a little Hyoscyamus or Conium.

Glandular Enlargements, and indolent inflammatory swellings,—the plaster as a stimulating alterative and resolvent.

VALERIANA,—Valerian.

Source and Composition. The root of *Valeriana officinalis*, a British plant of the nat. ord. Valerianaceæ. It contains a Volatile Oil, from which are developed by oxidation *Valerianic Acid*, *Valerene* and *Valerol*.

The Valerianic Acid of Pharmacy is a product of the oxidation of Amylic Alcohol (fusil oil);—it is not identical with the acid derived from the plant, though from it are prepared the Valerianates. (See below).

Preparations. The Oil is by far the best.

Abstractum Valerianæ, gr. x–ʒss. *Tinctura Valerianæ*, ʒss–ʒij.

Oleum Valerianæ, ♏ij–v. *Tinctura Valerianæ Ammoniata*, ʒss–ʒij.

The Ammoniated Tincture and Fluid Extract are extremely nauseous, and the latter is too bulky to be used. The taste is best covered by combination with Cinnamon. The various Valerianates (of Zinc, Ammonia, Iron, and Quinine) are made with the acid produced from Amylic Alcohol, and do not represent the action of the plant, but rather that of the bases from which they are respectively prepared.

Physiological Actions. Valerian is generally classed as an antispasmodic, or a nerve tonic. It is powerfully sedative to reflex excitability, and diaphoretic, laxative and anthelmintic.

Its taste and odor are horrible, except to cats, they being extravagantly fond of it. It greatly excites the sexual appetite in these animals, probably from the resemblance of its odor to their own when under venereal excitement. After a time, it produces in them violent spasms and convulsions.

In Full Doses it increases the action of the heart and raises the temperature, in most persons producing exhilaration, and in some slight mental disturbance, with formication of the hands and feet. It reduces motility and sensibility, and decreases reflex excitability, being antagonistic to the actions of Strychnine, Brucine, Thebaine, etc. Long used, it induces a condition of low melancholy and hysterical depression.

Large Doses cause hiccough, nausea, vomiting and diarrhœa, with tenesmus of the bladder, frequent micturition, and lithates in the urine. The mental disturbance may proceed even to delirium, while hallucinations and excitement are usually produced, together with great restlessness and spasmodic movements of the limbs.

Therapeutics. Valerian was formerly much used in *Epilepsy*, but it was probably only useful in the hysterical form (Hystero-epilepsy). It is a valuable remedy in—

Hysterical Disorders of all kinds, wherein it is often very beneficial.

Flatulence of the hysterical and in infants is quickly relieved by it.

Nervous Headache is often well treated by the Valerianate of Ammonium in 10-grain doses, administered in the form of an elixir.

Hypochondriasis,—especially at the climacteric period, with flatulence.

Coughs of nervous type, and *Whooping-cough,*—it is often efficient.

Diabetes Insipidus,—Valerian is more than palliative; in large and increasing doses it has frequently proved curative.

Convulsions due to worms,—Valerian is doubly indicated.

Delirium, with depression of the vital energies,—it is very beneficial.

Coma of Typhus,—the oil was remarkably successful in 135 cases out of a series of 172 treated by it.

SERPENTARIA,—Virginia Snake-root.

Source and Composition. The root of *Aristolochia Serpentaria,* and *Aristolochia reticulata,* plants of the nat. ord. Aristolochiaceæ, indigenous to the United States. It contains a Volatile Oil, a Camphor-resin, and *Aristolochine,* a bitter principle, soluble in both alcohol and water.

Preparations. They should be of the fresh root.

Extr. Serpentariæ Fluid., ♏x–xxx. *Tinctura Serpentariæ,* ʒss–ʒij.

Tinctura Cinchonæ Composita, ʒj–ʒij;—has 2 parts of Serpent. in 100.

Physiological Actions. Serpentaria is a stimulant tonic and expectorant, also a cardiac stimulant, as well as diaphoretic, diuretic, emmenagogue, aphrodisiac, and somewhat antiperiodic. Its taste is warm and pungent, its odor characteristic.

Small Doses promote appetite and digestion, increase the bronchial and intestinal secretions, the action of the heart, the cutaneous circulation, and the surface temperature; and produce considerable mental exhilaration.

Large Doses are irritant, causing nausea and vomiting, vertigo and headache, with colic, borborygmi, rectal tenesmus, flatulent distention, and frequent but not watery stools. The irritant action seems to produce gas rather than fluid. Itching of the anus and hemorrhoids are occasionally caused by its use.

Therapeutics. Serpentaria is chiefly used as a vehicle for other stimulant drugs, but has many uses of its own. In—

Bronchial Affections, it is exceedingly valuable as a stimulant expectorant, and may be combined with other expectorants.

Pneumonia of Typhoid form,—it is a good vehicle for Ammonii Carbonas.

Exanthemata, when depression exists,—it is a good stimulant.

Typhoid Conditions generally,—Serpentaria is well indicated.

Amenorrhœa of anæmia and chlorosis,—it is a useful emmenagogue.

Functional Impotence,—it will often restore the waning sexual power.

Remittent Fever,—as a vehicle for Cinchona it acts well.

Bilious Vomiting,—it checks the nausea and settles the stomach.

Diphtheria, *Scarlatina*, *etc.*,—An Infusion is excellent as a gargle.

CANNABIS,—Hemp.

Source and Composition. The flowering tops of *Cannabis sativa*, (nat. ord. Urticaceæ) varieties *Indica* and *Americana;* the latter having effects similar to but less powerful than those of the Indian plant. Both varieties are official. It contains a Resin, named *Cannabin*, and a Volatile Oil. From the oil are obtained a light hydrocarbon, *Cannabene*,—and a crystalline substance, *Hydride of Cannabene.*

The indigenous "Indian hemp," *Apócynum Cannábinum*, is a different plant, possessing active diuretic properties, but none others of marked character.

Preparations. There are but three official, viz.—

Tinctura Cannabis Indicæ, ♏v–ʒj. *Extr. Cannabis Indicæ*, gr. ¼–j.
Extractum Cannabis Indicæ Fluidum,—Dose ♏j–v.
**Cannabini Tannas*, Tannate of Cannabin,—Dose, gr. ij–x, in pill.

The corresponding preparations of *C. Americana* are given in somewhat larger doses, and are not official, though the plant itself is so recognized.

Preparations of Hemp commonly used in the East are—

Churrus,—an impure resin, obtained by rubbing the leaves together.

Gunjah,—the dried leaf as sold in the bazaars for smoking purposes.

Siddhi, Hashish or Bhang,—an Arabian confection, containing the leaves mixed with aromatics and various fruits.

Physiological Actions. Cannabis is antispasmodic, analgesic, anæsthetic and narcotic, a cerebro-spinal stimulant, and a powerful aphrodisiac. It increases intellectual and motor activity, stimulates the vaso-motor nerves, raising the arterial tension, and depresses sensation.

Large Doses cause a pleasurable intoxication, during which the traits peculiar to the individual are exalted; the ideas follow each other so rapidly as to produce a sense of great prolongation of time, minutes seeming as if hours or even days. With this occurs increased sexual desire, great muscular activity, and sensations of double consciousness and enormous dimensions; the sight and hearing are exalted, the pupils dilated, anæsthesia sets in, the reflexes are lowered by stimulation of inhibition (Setschenow's centre?); and if the dose be a heavy one a cataleptic state is induced. Sleep or coma follows, according to the size of the dose, but death has never been caused by this drug.

After-effects are dullness, heaviness, vertigo, headache, and confused thought; but no nausea, no vital depression, or constipation. Repeated use of the drug produces mental weakness and impotence, the result of over-stimulation. It causes a ravenous appetite, and increases the energy of the uterine muscular fibre, but has no power to initiate uterine contractions.

Therapeutics. Cannabis was formerly much used as an anodyne and hynoptic, and as an anæsthetic during surgical operations. It is out of fashion now, but very useful in—

Migraine, or sick-headache,—in which it often prevents the recurrence of the attacks, seeming to act specifically on Ringer's migraine centre.

Neuralgia,—full doses during the attack, smaller doses in the intervals.

Uterine Affections, as chronic metritis, subinvolution, menorrhagia, dysmenorrhœa, etc.,—its powers as an anodyne and stimulant of the uterine muscular fibre render it a very efficient agent.

Traumatic Tetanus, Paralysis Agitans, etc.,—large doses are required in order to lower reflex activity.

Delirium Tremens,—if any hypnotic be used here, Cannabis is the best.

Dysuria and retention of the urine are often relieved by it. In spasm of the bladder and other painful affections of that organ it will be found a most efficient remedy.

Impotence of functional character,—Cannabis is a very useful remedy and may be well combined with Ergot and Nux Vomica.

Gonorrhœa,—it lessens the discharge, inflammation, burning pain and restlessness, and allays chordee. The tincture of the American plant is very useful here, being fully as efficient as Copaiba or Sandal, and much more agreeable to the taste. It should be prepared from the fresh plant, and given in 3–5 drop doses 3 or 4 times a day, after the subsidence of the acute symptoms.

Insomnia,—especially that of acute mania,—the Tannate of Cannabin is recommended as a powerful hypnotic, but not a dangerous one, neither disturbing the secretions nor leaving unpleasant after-effects, if used in proper dosage, viz.,—gr. ij–x, the average being gr. v.

ERYTHROXYLON,—Coca.

Source and Composition. The leaves of *Erythróxylon Coca*, a sma Peruvian shrub of the nat. ord. Erythroxylaceæ, also called *Cuca*. It contains an active, crystalline alkaloid, named *Cocaine*, which by heat and HC Acid is resolved into Benzoic Acid and another alkaloid, *Ecgonine*;—also volatile, liquid alkaloid, *Hygrine*, an aromatic oil and Coca-tannic Aci Dose of the leaves, ʒ ss–ij.

[*Coca* should not be confounded with *Cocoa*, a beverage prepared from th seeds of *Theobroma Cacao*, the Chocolate-tree, for which see page 129.]

Preparations. Only the fluid extract is official.

Extractum Erythroxyli Fluidum, Fluid Extr. of Erythrox.—Dose, ʒ ss–ij.

**Cocainæ Hydrochloras*, Hydrochlorate of Cocaine,—Dose, gr. 1/8–j. Loca or hypodermically as anæsthetic, aqueous solutions of 2 to 5 per cent. (g jss–iij ad ʒj) are used; also Oleates, 5 to 20 per cent., made with th alkaloid itself and Oleic Acid.

* *Wines, Glyceroles, Pastes, Lozenges, etc., of Coca*,—are sold in great variet

Physiological Actions. In small doses Cocaine is a cerebral, cardia respiratory and nervous stimulant, and a diuretic. It improves digestio stimulates respiration, increases the heart's action, raises the arterial tensio and exalts the irritability of the sensory nerves. It stimulates the brain increasing its blood-supply, producing wakefulness and marked diminution the senses of fatigue and hunger. Though decidedly diuretic, it lessens t quantity of urea, by checking the processes of waste, thus acting as an indire nutrient, and enabling the body to maintain its energy on a lessened supply food. It increases the cutaneous circulation, flushing the surface, exci perspiration, and a sense of heat, and does actually raise the body-temperature. It dilates the pupil, both when locally applied and when taken systemically,—and stimulates intestinal peristalsis as well as the evacuation of the bladder in a few minutes after its ingestion.

An Overdose produces symptoms of cardiac and respiratory embarrassment in a very short time. The pulse, at first quick and forcible, becomes small, rapid and intermitting;—the heart apparently standing still in systole once in every 10 or 12 beats. Respiration is slow and shallow, and a sense of "tightness" about the chest is very marked;—the skin grows cold and clammy, and the subject is seized with a sense of impending dissolution. Death occurs in animals by paralysis of respiration,—but in man there seems to be a tetanoid spasm of the cardiac muscle, which is equally dangerous to life. Other symptoms are impairment of coördination, hallucinations and delirium. *Lethal Doses* paralyze the intra-cardiac motor ganglia, the posterior columns of the cord and the sensory nerves, and the respiratory centre.

As a *Local Anæsthetic* the power of Cocaine is very great over a limited area. Applied to such structures as the Schneiderian membrane, mucous covering of the glans penis; or injected hvpodermically in other locations, it blanches the structures and causes a profound but temporary anæsthesia throughout a small space. Applied to the tongue it temporarily destroys both taste and tactile sensibility;—to the ocular conjunctiva, it produces profound anæsthesia of that membrane, together with dilatation of the pupil, partial paralysis of accommodation, enlargement of the palpebral fissure, slight lachrymation, and sometimes temporary ptosis. This profound degree of anæsthesia is thought by some to be caused by its paralyzing the terminal twigs of the sensory nerves,—by others to be due to vaso-motor action rendering the nerves bloodless and therefore unable to transmit sensory impressions. It produces mydriasis by stimulation of the ends of the sympathetic in the iris, and does not affect the third nerve or the sympathetic centre.

In general action, *Cocaine* resembles *Atropine* very closely, especially in its influence upon the pulse and blood-pressure, the respiration, pupils, salivary- and sweat-glands and intestinal peristalsis. In its symptoms, both from large and small doses, it exactly parallels *Sparteine*, another cardio-inhibitory depressant.

Antagonists. *Amyl Nitrite* combats the earliest symptoms of cardiac depression,—then *Alcohol* and *Opium* as stimulants to the heart, also *Artificial Respiration*. The most direct antagonist is *Chloral*, so also are Chloroform and Ether. *Morphine* is also directly antagonistic at almost all points.

Therapeutics. Coca-leaves are habitually chewed by the Peruvian Indians, to sustain them during arduous labor. Their example was imitated by Weston, the pedestrian, during his protracted walks. In South America, it is used by 8 millions of people, much as we use tea and coffee. It is useful in—

Wasting Diseases, as a stimulant to digestion, and to retard waste.

Convalescence from fevers and other acute maladies;—a Wine of Coca.

Migraine and Neuralgia, with depression,—it is of real utility.

Vomiting of Pregnancy, and vomiting from any cause, it is efficient, even in the vomiting of Yellow Fever; 6–10-minim doses of a 4 per cent. solution every hour by mouth.

Stomatitis, Gastralgia,—for its benumbing effect on the mucous membrane.

As a Local Anæsthetic,—Cocaine has numerous applications, which are being extended more widely every day. It is already a necessity to the ophthalmologist, and the laryngologist, while for minor operations in general surgery and to relieve superficial pain, its use is becoming almost universal. In congestions of mucous surfaces it is being freely employed, also as a soothing and antiphlogistic application in skin diseases, to the uterus in labor, hypodermically for superficial neuralgiæ, and locally for itching from any cause.

Rhus Poisoning by either the oak or ivy, is promptly controlled by the application of a 5 per cent. solution or oleate, freely over the affected surface. It gives instant relief from the burning and itching, and speedily reduces the dermatitis. (Observation by author)

As a Mydriatic for ophthalmological use, Cocaine has peculiar qualities which make it the most serviceable of the class. The dilatation produced by it is great, is quickly attained, lasts only 12 to 20 hours, is promptly overcome by the application of Eserine, and is not accompanied by much photophobia. The latter is due to the fact that the cocainized pupil is not rigidly dilated, (as with Atropine), but reacts to light. The accommodation, moreover, is greatly reduced, but not entirely paralyzed, and is quickly regained.

CAFFEINE, THEINE, ETC.

The U. S. Phar. of 1880 defines *Caffeine* as "a proximate principle of feebly alkaloidal power, generally prepared from the dry leaves of *Camellia Thea*, * * or from the dried seeds of *Coffea arabica*, * * or from Guarana, and occurring also in other plants." According to this, the principles severally named Caffeine, Theine and Guaranine, were officially declared identical, and such was the general opinion until very recently; their composition being expressed by the formula $C_8H_{10}N_4O_2$, and the physiological action of one being accepted for the others. Recent investigations, however, leave no doubt as to the non-identity of the first two, and some observers maintain that Guaranine also is a separate body, distinct from either of the others. For the present, however, we must look upon it as identical with Caffeine.

Source of Caffeine. The seeds of *Coffea arabica*, the Arabian Coffee-plant, (nat. ord. Rubiáceæ),—of *Paullinia sorbilis*, Guarana, (nat. ord. Sapindaceæ), and other plants of different natural families, furnish the alkaloid *Caffeine*, which is distinguished among alkaloids by its containing more nitrogen than almost any other proximate vegetable principle. The seeds of the Coffee-plant also contain sugar, tannic acid, *Caffeic Acid*, etc. During the process of roasting the latter is partly converted into methylamin, the sugar is changed into caramel, and several volatile substances are formed, which give to coffee its peculiar aroma and some of its stimulant qualities, and are collectively known as *Caffeone*, one of them being called *Caffeol*. The Caffeine of commerce is usually obtained from old tea-leaves, and is in reality Theine.

Source of Theine. It is contained in the leaves of *Camellia Thea*, the tea-plant, a native of China and Japan, and a member of the nat. ord. Ternstromiaceæ. The tea-plant also contains tannic acid, and a volatile oil, the latter being most abundant in green teas.

Preparations. The first three are official.

Caffeina, Caffeine,—long, flexible, silky crystals, soluble in 75 parts of water, with bitter taste, but much more soluble in water having in solution the Benzoate, Cinnamate or Salicylate of Sodium. Dose, gr. j–v.

Guarana, Guarana,—a dried paste, prepared, (in Brazil), from the seeds of Paullinia sorbilis, a S. American climbing plant. Of very uncertain composition as it occurs in commerce. Contains 4 to 5 per cent. of *Guaranine*, an alkaloid considered identical with Caffeine. Dose, ʒj–ij in powder.

Extractum Guaranæ Fluidum, Fluid Extract of Guarana,—as unreliable as the product from which it is made. Dose, ʒj–ij, or more.

* *Caffeinæ Citras*, Citrate of Caffeine (B. P.). A very uncertain mixture, not considered a definite compound. Dose, gr. ij–x.

* *Theina*, Theine,—that from Merck the most reliable. Its solubility in water is much increased by adding an equal part of Sodium Benzoate, say ʒj of each to the fluid ℥, with gr. x of Sodium Chloride. Of this, ♏vj equals gr. ½ of Theine. Dose, gr. ⅙–j, hypodermically, several times a day, for relief of pain.

Physiological Actions of Coffee. It is a cerebro-spinal stimulant, a stomachic tonic and a laxative. It is decidedly diuretic, and when roasted it is somewhat antiperiodic and highly antiseptic. The green bean produces very different effects from those of the roasted one, exhibiting the action of Caffeine alone, unmodified by that of the empyreumatic products. A tincture of green coffee, besides being an efficient diuretic, has marked anti-lithic powers, and promotes the elimination of the poison of gout from the system.

As a beverage, if used with moderation Coffee assists digestion, promotes intestinal peristalsis, allays the senses of fatigue and hunger, lessens tissue-waste and consequently decreases the formation and excretion of urea (?). Used to excess it disorders digestion, and causes functional disturbances of the nervous system, shown by headache, vertigo, mental confusion, and palpitation of the heart.

It increases secretion, blunts sensation, exalts reflex excitability, increases mental activity, and may produce insomnia and great nervous restlessness. It first briefly stimulates the heart and raises arterial tension, but soon depresses both. The wakefulness is usually preceded by a brief period of drowsiness.

The brief stimulation of the intellect, consequent on drinking a cup of good coffee, cannot be obtained from an infusion of raw coffee, and is probably due to the volatile constituents developed in roasting. *Caffeone* opposes Caffeine in its action on the circulation, as it quickens the pulse and lowers arterial tension. Its action, however, is of brief duration, and soon gives way to the influence of the principal constituent. The *Tannin* is the ingredient which enables it to produce dyspepsia, and is most abundant in those infusions which are kept a long time on the stove before being served.

The Common Stimulant Beverages Compared.

The Qualities possessed in common by these substances, and for which they are so universally esteemed by mankind, are three-fold. They all (1) retard the retrograde metamorphosis of the body-tissues, (tissue-waste);—thereby enabling the work of the individual to be done upon a smaller supply of reparative material, (food), and with less fatigue. Furthermore, when used in moderation, they are all (2) more or less stimulating to the mental processes. and (3) sedative to the nervous system.

This similarity of action they owe to the possession of principles, which, if not identical, are so closely related to each other that until very recently they have been so considered both by chemists and pharmacologists. Their divergence from each other, in the finer shades of their action, depends most probably on the existence in each of differing aromatic and volatile principles, which modify the action of the alkaloid in some degree. Similar principles are developed in them by the various processes of preparation, (as roasting, drying, etc.), all of which have some part in determining the general action of the beverage containing them.

Coffee is more stimulating than Coca, and less sustaining. It is apt to cause severe palpitations of the heart; and may disorder digestion, if long stewed. The Coffee-bean contains only 0.2 to 0.8 per cent. of Caffeine.

Tea (*Camellia Thea*) is the most refreshing and stimulating member of the group. Used to excess, it powerfully affects the stability of the motor and the vaso-motor nerves, the action of the heart, and the digestive function,—producing flatulent dyspepsia, tremulousness of the limbs, pallor of the surface, irregular cardiac action, and feeble impulse, hallucinations, night-mare, anorexia, headache, nausea and vomiting, obstinate neuralgiæ—especially of the supra-orbital and occipital nerves; also constipation, and a pain in the left side are not infrequent. The condition of chronic tea-poisoning is termed "Theism,"—and is very often seen among women of the lower class in cities, who do not indulge in alcoholic beverages, but freely accept the dominion of the "cup that cheers" and worse than inebriates.

Maté (*Ilex Paraguayensis*, Paraguay tea), is supposed to be intermediate in its effects between tea and coffee. It also contains Caffeine, in the proportion of 1.2 per cent.

Guarana (*Paullinia sorbilis* of Brazil), contains an alkaloid—*Guaranine*, in the proportion of 5 per cent., which is probably identical with Caffeine, though some think it more analogous to Theine. It is especially noted for relieving a nervous headache, for which purpose the official fluid extract may be used in doses of ♏ xx, three or four times daily, when the basis of that preparation happens to be of good quality.

Coca, or **Cuca**, (*Erythroxylon Coca*, see page 124), is more sustaining and less of a direct stimulant, than either tea or coffee. The proportion of Cocaine in the leaves varies greatly in different samples, as they occur in commerce.

Cocoa (*Theobróma Cacao*, the Chocolate-tree), is more directly nutritious than any of the group, containing a large quantity of fat, *Oleum Theobromæ* (cacao-butter), which makes it difficult of digestion to many persons. Its alkaloid, *Theobromine*, is closely allied to Caffeine, the latter being considered a Methyl-theobromine. The various preparations of this agent are made from the seeds, after the oil has been expressed from them. They are ground in a mill, mixed with rice, barley, sugar, flour, etc., and put up in powdered form, called *Cocoa*,—but if flavored with vanilla and pressed into a cake, the product is *Chocolate*. The thin husks which envelope the seeds are known as "*Shells*," and are used to make a beverage similar to but milder than cocoa or chocolate.

Physiological Action of Caffeine in general terms is that of a stimulant at first, and subsequently a paralyzant, to the nerve-centres in the cerebrum, medulla and cord. In small doses it quickens the action of the heart and raises arterial tension; stimulates the cerebral functions, by increasing the supply of blood to the brain; increases the respiration rate and the secretion of urine. Larger doses, (gr. v–viij), often over-stimulate the cerebral circulation, causing thereby great heaviness of the head, flashes of light before the eyes, tinnitus aurium, insomnia, restlessness, and even delirium,—the pulse becoming rapid, feeble, irregular and intermittent, and the general body-temperature elevated, though that of the periphery may be lowered. Large doses depress the heart and respiration, and lower the blood-pressure;—in the smaller animals exalting the reflex excitability of the cord and producing tetanic convulsions;—and in lethal doses paralyzing the cardiac muscle as well as its motor ganglia, but causing death by paralysis of respiration. It powerfully affects muscular fibre, both voluntary and involuntary kinds, throwing it into a state of tetanic contraction resembling rigor mortis. If administered in sufficient quantity it would doubtless prove fatal to man,—but its lethal dose for him would be very large. Caffeine is excreted unchanged in the bile and urine, and is a reliable hydragogue diuretic; acting by stimulation of the secreting apparatus in the kidney, as well as by generally raising the arterial tension (Brunton).

Action of Theine, upon the smaller animals, agrees in most respects with that of Caffeine, except that it requires much larger doses to produce the same effects. It differs, however, in some important particulars. Theine chiefly affects the sensory, Caffeine the motor system. Theine causes spasms and convulsions, and impairs the nasal reflex, early in the course of the poisoning process;—while Caffeine does so late, if at all. Theine decreases the body-temperature,—Caffeine increases it. Theine causes convulsions in frogs, a power now denied to Caffeine, though hitherto ascribed to it. Both alkaloids tend t produce muscular contraction, but Theine causes a peculiar rhythmical contraction in voluntary muscles, which lasts for several hours, and seems to ac transversely across the fibre, as the muscle is elongated at each contraction. In man, the principal action of the hypodermic injection of Theine is the production of a profound local anæsthesia at and below the point of injection,—acting therefore outwards along the nerve-trunk, and not towards the centre. It does not affect the motor apparatus, nor does it seem to produce narcosis.

Guaranine is generally considered as identical with Caffeine, though some few observers find in its action a closer analogy to Theine. It affects bot sensory and motor nerves, the sensory first, paralyzing them from the centres outwards. [*Cocaine* and *Brucine* act from the periphery inwards.] It causes general hyperæsthesia, and subsequently convulsions of spinal origin,—at first increases and afterwards depresses respiration and the action of the heart. It seems to have a stronger affinity for the sensory than for the motor nerves, and hence resembles Theine more than Caffeine.

Theobromine has the formula $C_7H_8N_4O_2$, and is closely allied to Caffeine, physiologically and chemically. In fact, Caffeine may be considered a Methyl-theobromine, $C_7H_9(CH_3)N_4O_2$. During roasting the cocoa-bean develops an aromatic principle which gives to chocolate its peculiar flavor. In large doses Theobromine is fatal to small animals.

Therapeutics of Caffeine. Although without a very extensive range of usefulness, Caffeine is a valuable stimulant in many forms of nervous and cardiac depression, and has proved especially efficacious in—

Headaches of neuralgic or nervous type, the pain being general over the head,—gr. j of Caffeine every half hour, or the fluid extract of Guarana, in 20-minim doses every 2 or 3 hours.

Choleraic Diarrhœa, and that of phthisis,—it checks outward osmosis by stimulating the depressed nervous apparatus.

Dropsy, cardiac and renal,—Caffeine as a diuretic and cardiac stimulant.

Cervico-brachial Neuralgia,—Caffeine hypoder., gr. j, increased to gr. v.

Lithæmia and Gout,—a tincture of the green bean has marked diuretic and antispasmodic powers, and is very useful in these conditions.

Insomnia of chronic alcoholism,—gr. ½ of Caffeine hypodermically.

Adynamic Fevers,—it may well be used in place of alcoholic stimulants.

Intermittents,—Coffee has a curative reputation among the inhabitants of the Philippines, which is corroborated by the Dutch physicians.

Asthma,—if not used habitually, Coffee is valuable in the paroxysm.

Opium Narcosis,—Caffeine hypodermically, or better still, strong black coffee, to antagonize the increasing torpor of the nervous centres.

Therapeutics of Theine. This alkaloid is a valuable analgesic, especially o by reason of its prolonged influence over sensation. Its great field of mployment is in—

Neuralgia of any kind, cervico-brachial, sciatic, etc., doses of gr. ⅙ to gr. ½ hypodermically, are efficient, and may be kept up as long as required. To make a cure, however, the nutrition of the nerves must be attended to.

Locomotor Ataxia, *Lumbago*, etc.,—it has been used with prompt benefit, in the same manner, promptly relieving pain, without producing any narcotic effect. (Mays).

CEREBRAL DEPRESSANTS.

ALCOHOLS and ALDEHYDES.

An Alcohol is a volatile organic compound of an organic radical and Hydroxyl (HO), contains no N, has a great affinity for water, and reacts with acids to form H_2O and Ethers. Alcohols are therefore analogous to the metallic hydrates, and Ethers to metallic oxides or salts.

An Alcohol is obtained by distillation from the fermented product of grape-sugar, or some substance (as starch) easily converted into grape-sugar, which in the presence and by the growth of certain low vegetable organisms (the yeast-plant, etc.) splits up into Alcohol and CO_2. It may also be made synthetically by shaking Olefiant Gas (C_2H_4) with strong Sulphuric Acid, then diluting and distilling. $C_2H_4 + H_2O = C_2H_6O$, Ethylic Alcohol.

Three most important Alcohols are the following-named, viz.—

Methylic Alcohol, $CH_3 + HO = CH_4O$, Methyl Hydrate, Wood Spirit,—One of the products of its oxidation is Methylal, (see under CHLORAL).

Ethylic Alcohol, $C_2H_5 + HO = C_2H_6O$, Ethyl Hydrate, Grain Spirit, the substance commonly styled "Alcohol." Its oxidation products depend upon the rate of its oxidation. If very slowly it forms Aldehyde, C_2H_4O,—if more quickly Acetic Acid, $C_2H_4O_2$,—if very quickly, as in burning, CO_2 and H_2O, which are, in all cases, the ultimate products of its continued oxidation.

Amylic Alcohol, $C_5H_{11} + HO = C_5H_{12}O$, Amyl Hydrate, Fusil Oil, Potato-spirit,—also occurs in the excessive distillation of fermented grain, along with the Ethylic Alcohol. Its oxidation produces Valerianic Acid, $C_5H_{10}O_2$.

An Aldehyde is obtained from an alcohol by removing therefrom two atoms of hydrogen, hence its name—*Al*(cohol)*dehyd*(rogenatum). Aldehydes lie in chemical constitution between the alcohols and the acids, and have the power of reducing silver salts in darkness, which is shared also by living protoplasm. The principal aldehydes are—

Acetic Aldehyde, C_2H_4O, Aldehyde, Ethyl Aldehyde, Ethylidene Oxide,—a colorless, mobile liquid, antiseptic, locally irritant, anæsthetic when inhaled, and a powerful depressant of the respiration, so that it is too dangerous for use.

Paraldehyde, $C_6H_{12}O_3$,—a polymeric form of Aldehyde, and a valuable hypnotic,—See under CHLORAL.

A Ketone bears the same relation to an Aldehyde that an Ether does to an Alcohol,—being an aldehyde in which the hydrogen has been replaced by a radical. The most important Ketone is—

Hypnone, $C_6H_5(CO)(CH_3)$, Phenyl-methyl-acetone. A powerful hypnotic, described under CHLORAL, on page 142.

Official Preparations of Alcohol and those in general use, are—

**Absolute Alcohol*, sp. gr. 0.794. That of the shops is rarely stronger than 98 per cent.

Alcohol, sp. gr. 0.820, contains 91 per cent. by weight of absolute Alcohol.

**Alcohol*, Rectified Spirit, sp. gr. 0.835, contains 85 per cent. of absolute Alcohol. Has no Fusil Oil. It is often spoken of as "56 over proof," meaning that to reduce 100 volumes of it to the strength of proof spirit requires 56 volumes of water.

**Proof Spirit*, sp. gr. 0.920, contains 49 per cent. of Alcohol.

Alcohol Dilutum, sp. gr. 0.928, contains equal measures of Alcohol and Water.

Spiritus Frumenti, Whiskey, from rye or corn, (U. S.), barley (Scotch), potatoes (Irish). It has 44 to 50 per cent., by weight, of Alcohol, also Ethers developed by the action of Acetic and Butyric Acids on the Alcohol, and traces of Fusil Oil, even in the best. It should be at least two years old.

Spiritus Vini Gallici, Brandy. Pale, colored by cask. Dark, has caramel. Its Alcoholic strength is the same as Whiskey, and its Ethers are developed by age. Supposed to be distilled from grapes; but is generally prepared artificially by adding to high wines Acetic or Nitric Ether, Caramel, and Logwood or Catechu, for astringency. It should be at least four years old.

Vinum Album, White Wine. It should contain 10 to 12 per cent. by weight of Alcohol, and is made by fermenting the unmodified juice of the grape, freed from seeds, stems and skins.

Vinum Album Fortius, Stronger White Wine. It should contain 20 to 25 per cent. of Alcohol by weight; and is made by adding 1 part of Alcohol to 7 of Vinum Album.

Vinum Rubrum, Red Wine, is made by fermenting the juice of colored grapes with their skins. It should contain 10 to 12 per cent. by weight of Alcohol, and from 1½ to 3½ per cent. of Tannic Acid.

†*Rum* is obtained from the distillation of fermented molasses.

†*Gin* is distilled from rye or barley, and flavored in Holland with Juniper berries and Hops; in England often with Oil of Turpentine, various cheap Aromatics, Acetate of Lead, Sulphate of Zinc, Cayenne Pepper, etc. Pure gin is an efficient diuretic, from the Oil of Juniper contained in it, but it is so rarely obtained pure that other diuretics are better employed.

†*Vinum Portense*, Port Wine, has 30 to 40 per cent. Alcohol. Is almost impossible to be obtained pure, being usually made artificially and heavily fortified with Alcohol.

†*Vinum Xericum*, Sherry, a dry spirituous wine, also generally made to order by the so-called rectifiers; the process being one of slow heating.

**Sparkling Wines*, Champagne, Catawba, etc., are sweet, being bottled before fermentation has ceased; have 8 to 12 per cent. Alcohol, and considerable CO_2.

**Sweet Wines*, Burgundy, Tokay, Muscatel, Malaga, Angelica, Madeira, etc., are of low Alcoholic strength, 6 to 7 per cent., unless fortified.

**Light Red Wines*, Claret, Red Rhine, Concord Port, have 5 to 6 per cent. Alcohol, Tannic Acid, grape coloring matter, etc.

**Dry Acid Wines*, Rhine, Moselle, Ohio, Catawba, etc. Fermentation complete. Alcohol 5 to 7 per cent.

**Beer*, by slow fermentation, yeast falling. Alcohol 2 to 3 p. c.
**Ale*, by rapid fermentation, yeast floating. Alcohol 2 to 6 p. c.
**Porter*, *Stout*, have much coloring matter. Alcohol 4 to 6 p. c.
} Also contain Extract of Malt, CO_2, Lactic Acid, salts of Potassium and Sodium, Aromatics, etc.

Qualities necessary in a good Wine. Unity of taste, bouquet, body, flavor and satisfaction to the palate of the consumer. The bouquet (aroma) is due to Œnanthic Ether, produced by the reaction of Œnanthic Acid and the Alcohol.

Physiological Actions of Alcohol. It is a cerebral excitant and depressant, and a narcotic poison. It is anæsthetic, antiseptic, and anti-parasitic, a mild counter-irritant, and coagulates albumen by abstracting its water. It is very diffusible, partly oxidized by the organism, partly excreted.

In Small Doses Alcohol relaxes the vessels, stimulates the gastric glands, promotes appetite and digestion, lessens the elimination of waste products (Urea and CO_2), causes a subjective sensation of heat, and slightly raises the body temperature. It briefly stimulates the heart, prolonging its systole and reducing the length of the diastole, and increases the functional activity of all the organs. A portion is oxidized by the organism (℥iss in 24 hours?), yielding force, which is utilized as nervous, muscular and glandular power.

The continued use of small or moderate doses congests the stomach and liver, over-stimulates the gastric glands and the hepatic cells to the production of pathological secretions, causes gastric catarrh and morning vomiting of mucus, and impairs digestion. By irritation it sets up hyperplasia of the submucous connective tissue (sclerosis), especially in the stomach, brain, kidneys and liver (cirrhosis); produces fatty degeneration (steatosis) of the blood, the arterial walls, and the various organs; and depresses the heart and the arterial tension. Epilepsy, paraplegia, amaurosis and insanity may result from the long continued use of spirits, Alcohol having an especial affinity for the nervous system. The malt liquors (beer, ale, etc.,) are less prone than the spirituous to affect the brain, but are very apt to set up fatty degeneration of the liver and heart.

In Large Doses Alcohol precipitates pepsin and destroys its activity as a ferment, arrests digestion, produces exhilaration, intoxication, hallucinations, delirium, muscular incoördination, depression of the heart, lowered arterial tension and body temperature, abolished reflexes and coma.

A Toxic Dose, after a very brief period of excitement, produces insensibility, stertorous breathing, dilated or contracted pupils, complete muscular resolution, and death by paralysis of the heart and respiration.

Alcohol is a food within narrow limits; ℥iss per diem (?) is the quantity which the adult organism can oxidize; more than this is a poison (?), setting up structural changes in the organs, and lowering the resistance power of the body to morbific influences. It has frequently caused an intractable form of phthisis. The very young and the very old bear more Alcohol relatively than the adult. Alcohol has been proven to exist normally in the human organism.

Morbid Conditions with which Acute Alcoholism may be Confounded. Apoplexy, opium narcosis, concussion of the brain, and even acute pneumonia. The differential diagnosis is impossible to make in the state of deep coma. The pupils are not a trustworthy indication, as in alcoholism they may be either dilated or contracted.

Treatment of Acute Alcoholism. Evacuate the stomach, Ammonia inhalation cautiously, warmth to the extremities, cold affusion to the head, faradism of the muscles of respiration.

Therapeutics. Though decidedly injurious in health, in disease Alcohol is a most valuable agent for appropriate cases. In—

Vomiting of yellow fever, sea-sickness, etc.,—Iced Champagne is useful.

Atonic Indigestion of nervous and depressed subjects,—cautiously, lest the alcohol habit form.

Phthisis,—it does good if it promotes digestion and assimilation; otherwise it is very injurious.

Cholera Infantum, Diarrhœa, etc.,—Cognac Brandy in full doses is generally an efficient agent.

Cardiac Failure,—Brandy in small doses repeated as fast as oxidized.

Chloroform Anæsthesia,—℥j–ij of Whiskey beforehand, to sustain the heart, and prolong the chloroform narcosis.

Poisoning by cardiac depressants and snake-venom,—Alcohol freely, to sustain the heart. In snake poisoning it is given *ad libitum*.

Diphtheria,—Whiskey or Brandy in small doses frequently from the commencement, and dilute Alcohol sprayed into the throat, is very efficient treatment.

Adynamic Fevers,—Small doses frequently are often of great value.

Gonorrhœa,—Niemeyer did a lucrative business by treating this affection with injections of Tannic Acid in Port Wine.

Insomnia from cerebral anæmia,—may be prevented by small doses at bedtime of some alcoholic stimulant.

Delirium Tremens is relieved by small doses of Alcohol with aliment, when due to failure of the stomach to appropriate food.

Wounds,—no better dressing than strong Alcohol, to prevent putrefaction and protect the surface by coating it with a coagulum of its albumen.

Bed Sores if threatening,—Alcohol locally, to harden the tissue.

Colds, from exposure, may be prevented by small doses of Alcohol, to restore the balance of the circulation and prevent internal congestions, by relaxing the vessels of the periphery.

ÆTHER,—Ether.

The substance improperly called "Sulphuric Ether" or "Ether" is *Ethy Ether,* or the *Oxide of Ethyl,* $C_4H_{10}O$. It is a derivative of Ethylic Alcoho prepared by its distillation with Sulphuric Acid, the latter body dehydrati the Alcohol and remaining in the retort. $(C_2H_6O)_2 - H_2O = C_4H_{10}O$.

Properties. Ether is a volatile, colorless, inflammable liquid, lighter th water; its vapor being heavier than air, and forming therewith a highly exp sive mixture. It is a solvent of oils, fats, resins, caoutchouc, gutta percha, many other substances.

Official Preparations and Chemical Analogues.

Æther, sp. gr. 0.750, contains about 26 per cent. by weight of Alcohol and little Water.

Æther Fortior, Stronger Ether, sp. gr. 0.725, Ethyl Oxide, $C_4H_{10}O$. Wrong called "Sulphuric Ether." Contains about 6 per cent. of Alcohol, and little Water.

Æther Aceticus, Acetic Ether, sp. gr. 0.890, Acetate of Ethyl, $C_4H_8O_2$. Use in making the Spiritus Odoratus, and the Tinctura Ferri Acetatis.

**Sulphuric Ether,* properly so called, Ethyl Sulphate, $C_4H_{10}SO_4$.

**Nitrous Ether,* Ethyl Nitrite, $C_2H_5NO_2$. A solution of this in Alcohol is t well-known diuretic and diaphoretic—*Spiritus Ætheris Nitrosi,* Spirit Nitrous Ether, Sweet Spirit of Nitre,—Dose ♏v.–ʒij.

Spiritus Ætheris, Spirit of Ether, ♏v–ʒj. Ether 30 parts, Alcohol 70.

Spiritus Ætheris Compositus, Compound Spirit of Ether, Hoffman's Anody contains Alcohol 67, Ether 30, Ethereal Oil 3. Dose ♏v–ʒj.

Anæsthetic Mixtures,—have Ether 3 parts, Chloroform 2 or 1, Alcohol 1.

Physiological Actions. Ether is anodyne, antispasmodic, diaphoretic, and anthelmintic, a cardiac and cerebral stimulant, an anæsthetic, and a narcotic poison. Administered internally it is one of the most powerful secretion-stimulants known, acting especially on the secretions of the stomach, salivary glands, and pancreas. On the cerebrum and the motor and sensory nerves, its action is similar to that of alcohol, but more prompt and less protracted. It is eliminated quickly, chiefly by the lungs.

Inhaled, it produces at first faucial irritation, a sense of strangulation, and cough, then a stage of excitement (cerebral intoxication), in which the face is flushed and the respiration and pulse are quickened. A tetanic convulsive stage generally follows, the face being cyanosed, the muscles rigid, the respiration stertorous. This soon subsides, and complete insensibility is established, the muscles being relaxed, and the reflexes abolished. The cerebral functions are suspended, the lower centres in the medulla continuing to carry on the processes of respiration and circulation. If the inhalation be continued these too become paralyzed, death usually resulting from slow paralysis of respiration, the heart pulsating long after breathing has ceased. [Chloroform usually paralyzes the heart.] *Atropine* hypodermically is the best antagonist to the toxic effects of ether.

Nitrous Ether is a mild diaphoretic, a carminative, and a most efficient diuretic.

Therapeutics. When diluted with Alcohol, Ether mixes readily with Water, and may be administered internally in—

Indigestion of Fats, and to aid the digestion of Cod-liver Oil.

Gastralgia, Colic, Flatulence, etc.,—Hoffman's Anodyne is admirable.

Hepatic Colic,—Durande's solvent remedy consists of Ether and Turpentine, and is supposed to dissolve hepatic calculi.

With Opium,—to counteract the drying up effects of that drug.

Syncope is promptly met by Hoffman's Anodyne.

Hysteria, the paroxysm and flatulence, are quickly relieved by Ether.

Cholera, the algid state,—Ether has been well used subcutaneously.

Neuralgia,—Ether injected into the vicinity of the affected nerve.

Local Anæsthesia by Ether-spray, affords great relief in neuralgia of superficial nerves, lumbago, spinal irritation, chorea; and in minor surgical operations it is a valuable method, but now displaced by Cocaine.

As an Anæsthetic,—Ether is less prompt in action but much safer than Chloroform, as it never paralyzes a healthy heart. It has its necrology, however, some 27 deaths being reported as undoubtedly caused by it, besides several which occurred some hours after the anæsthesia. Ether should be inhaled in as concentrated a form as possible, and will then produce insensibility in

3 to 8 minutes. If a light be in the room it should be high above the patient. A grate-fire or gas stove in the vicinity is very dangerous. [Compare *Chloroform.*]

CHLOROFORMUM,—Chloroform.

Chloroform is the *Ter-chloride of Methyl*, or *Methylic Ether*, $CHCl_3$, prepared by the action of Chlorinated Lime upon Alcohol. It was discovered by Samuel Guthrie, of Sackett's Harbor, N. Y., in 1831.

Properties. It is a colorless, neutral fluid, practically non-inflammable, soluble in alcohol, ether, olive oil and turpentine, and 200 of water. Its density and weight are about four times those of air. It dissolves caoutchouc, gutta percha, oils, fats, resins, many of the balsams, and most of the alkaloids.

Preparations.

Chloroförmum Venale, Crude Chloroform,—sp. gr. at least 1.470. For local use. Contains hydrocarbons, free chlorine, acids, etc.

Chloroförmum Purificatum, Purified Chloroform, sp. gr. at least 1.485. Dose, ♏j–ʒss, diluted, internally;—ʒj–℥j by inhalation.

Spiritus Chloroformi, Spirit of Chloroform, Chloroform 10 parts to 90 of Alcohol. Dose, ♏v–ʒij well diluted.

Mistura Chloroformi, Chloroform Mixture. Dose, ʒj–℥j. Chloroform 8 parts, Camphor 2, Albumen 10, Water 80.

Linimentum Chloroformi, Chloroform Liniment,—has of Chloroformum Venale 40 parts, Linimentum Saponis 60. An anodyne for local use.

**Linimentum Chloroformi Compositum*, Compound Chloroform Liniment,—Chloroform 1, Oil of Turpentine 1, Laudanum ½, Tinct. Aconite ¼, Soap Liniment 2 parts by volume. An excellent anodyne application.

* *Chlorodyne*, Chlorodyne,—A secret and very dangerous proprietary preparation, supposed to contain Chloroform, Ether, Morphine, Cannabis Indica, Hydrocyanic Acid, Treacle, etc. Dose, ♏v–xxx. Imitations are prepared by several manufacturing drug-houses, and are sold under the names *Chloranodyne*, *Elixir Chloroformi Compositus*, etc. A comparison of the published formulæ of ten different samples, shows that they contain Morphine in various proportions, namely from ¼ gr. to 8½ grains in the fluid ℥;—or, taking the average dose at ♏xv, the contained quantity of Morphine would vary from gr. $\frac{1}{128}$ to gr. ¼ per dose. A similar preparation was introduced into the last edition of the British Pharmacopœia, under the title *Tinctura Chloroformi et Morphinæ*, of which each 10-minim dose contains ♏1¼ of Chloroform, gr. $\frac{1}{48}$ of a Morphine salt, and ♏⅝ of Dilute Hydrocyanic Acid, with other ingredients.

* *Anæsthetic Mixtures.* That of Nussbaum has of Ether 3 parts, Chloroform 1, Alcohol 1. Another, much used, contains of Ether 3 measures, Chloroform 2, Alcohol 1.

Actions of Chloroform compared with those of Ether. Chloroform is much more irritant to the mucous membranes, and causes violent gastro-enteritis if swallowed undiluted. It is less of a stimulant, and more depressant to the heart and circulation. It clots the blood outside the body, making a mass like sealing-wax. A large dose swallowed has caused death. *Inhaled*, it is much more dangerous than Ether, from its direct paralyzant effect on the heart. Its vapor requires admixture with 96½ per cent. (?) of air to produce anæsthesia with safety. Its vapor is less irritant, however, to the air passages, uninflammable, more pleasant, more prompt in action, has a shorter stage of excitement and a more profound narcosis, and does not cause so much vomiting. About 500 fatal cases from its inhalation are now reported, none of which were in obstetrical practice. Chloroform mortality is 1 in 3,000; Ether mortality, 1 in 16,000. *Death* from Chloroform inhalation is almost always sudden, and by cardiac paralysis,—from Ether it is slow and usually by paralysis of respiration.

Modes of Dying from Anæsthetic vapors. (1) Death may occur early in the inhalation, from sudden paralysis of the cardiac ganglia. Or by a small quantity of Chloroform given for minor operations the cerebral hemispheres may be suspended, but not the basal or medullary ganglia, permitting the irritation of a sensory nerve (especially the 5th) to transmit reflex inhibition over the pneumogastric upon the heart, thus arresting the action of its motor ganglia.* The state of incomplete anæsthesia is always a dangerous one in which to perform any operation, especially when the 5th nerve is implicated therein, as in the extraction of teeth.

(2) In the stage of rigidity, from fixation of the respiratory muscles, the blood backing up on the venous side and arresting the heart's action.

(3) In the stage of complete relaxation, by paralysis of respiration; or by paralysis of the tongue, causing obstructed respiration.

(4) In the same stage, by paralysis of the cardiac ganglia.

(5) From depression of the functions, or shock, in the anæsthetic state, or afterwards.

Contra-indications for the use of Anæsthesia. Fatty degeneration or dilatation of the heart, kidney disease, emphysema of the lungs, very enlarged tonsils, tumor of the brain, and chronic alcoholism—particularly the first and last named.

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* The author has seen the heart stopped by the irritation produced by the operation of vaccination. The subject was a young man, having a weak heart, but otherwise in perfect health.

Treatment of Dangerous Symptoms. The vapor should be withdrawn and the patient inverted, head downwards, if cardiac failure occurs. Drawing the tongue forwards, artificial respiration, and faradization of the respiratory muscles, if breathing ceases. Warmth to the body and limbs. *Atropine* by hypodermic injection.

If swallowed, the stomach should be evacuated, and the case treated as one of poisoning by an irritant. There is no *chemical antidote*.

Therapeutics of Chloroform. It is used for the same conditions as is Ether, and is much employed locally in liniments, as a rubefacient and anodyne, as in—

Rheumatic and Neuralgic Pains of chronic character,—with Oil of Turpentine or Camphor, in a soap liniment. See Linim. Chlorof. Comp. p. 138.

Cholera,—the Spirit, or Chlorodyne, has been more efficacious in true cholera than any other single remedy.

Respiratory Neuroses, as hay fever, spasmodic asthma, reflex cough, etc.—the vapor of ʒj of the Spirit inhaled from hot water.

Sciatica, Tic-douloureux and other neuralgiæ of important nerves,—the deep injection of ♏v–xv (?) of pure Chloroform into the vicinity of the nerve is most efficient treatment (Bartholow). In my only case it caused dangerous local disturbance (H. C. Wood).

As an Anæsthetic its use is lessening every year in favor of Ether, except in obstetrical practice and for young children. Its vapor being four times denser and heavier than air, and its effective use requiring not more than 3½ per cent. (?) of Chloroform vapor, its administration requires most careful management. Dr. Sayre ignores the foregoing rule and always shuts off all atmospheric air, claiming a more complete anæsthesia from a very small quantity (♏xv–xx) of Chloroform.

An ounce of Brandy, and a subcutaneous injection of Morphine, gr. $\frac{1}{4}$ and Atropine, gr. $\frac{1}{120}$, twenty minutes before commencing the inhalation, are means of great utility in sustaining the heart and respiration, and in rendering the anæsthesia more profound.

CARBONEI BISULPHIDUM,—Bisulphide of Carbon.

Properties. Bisulphide of Carbon (CS_2) is a clear, colorless, diffusive neutral liquid, highly inflammable, vaporizes at ordinary temperatures; insoluble in water, but soluble in alcohol, ether, chloroform, and oils. It is an cient anæsthetic, but of horribly offensive odor. It may be administered in doses of ♏ss–j, internally.

Physiological Actions. Being largely used in the arts, its effects are often seen in the operative class. Its vapor produces headache, vertigo, emaciation, incoördination of movements, and depression of all the special senses, with impaired sensation and motility. Inhaled, it excites violent coughing, and produces anæsthesia, characterized by muscular rigidity, but it is a powerful cardiac paralyzant, and hence extremely dangerous as an anæsthetic. In doses of gtt. iij it produces severe nausea and vomiting, with a sensation of heat in the stomach, and a rapid and weak heart.

Therapeutics. It may be used in—*Irritable Ulcers*,—as a local application to set up a substitutive inflammation, which replaces the original disease. *Gastralgia*,—doses of ♏ss have been serviceable. *Gastric Cancer*,—it alleviates the pain. *Nausea and Vomiting* are relieved by ♏ss doses.

CHLORAL, CROTON-CHLORAL, ETC.

Chloral itself is Tri-chlor-aldehyde, C_2HCl_3O, an unstable, oily, colorless fluid, formed by the action of Chlorine upon Alcohol. Its hydrate, the official "Chloral," C_2HCl_3O, H_2O, is a white crystalline solid, soluble in Alcohol, Water, and Glycerin, and is decomposed by alkalies into Chloroform and a Formiate of the alkaline base. Its dose is gr. ij–xx or more, but poisonous symptoms have followed the administration of gr. xxx, and in one case after only gr. vijss. When tolerance has been established by habitual use, as much as ʒiij have been taken daily, for months.

Analogues of Chloral.

***Croton-chloral**, $C_4H_5Cl_3O,H_2O$, *Butyl-chloral Hydrate* (B. P.),—a crystalline body formed by acting on Aldehyde with Chlorine. It is sparingly soluble in water, (1 in 100), but is readily so in glycerin (1 in 4). In action it closely resembles Chloral, but is feebler, less depressant to the heart, and generally less poisonous, but more disagreeable to the taste. It is said to specifically affect the fifth nerve, and to cause anæsthesia over its distribution long before producing general anæsthesia (Liebreich). Dose, as hypnotic, gr. v–xx.

***Paraldehyde**, $C_6H_{12}O_3$,—a polymeric form of Aldehyde, if represented thus $(C_2H_4O)_3$. Occurs as a strong-smelling, bad-tasting fluid, soluble in 8 parts of water. It is a reliable hypnotic of about one-half the power of chloral, leaving behind no unpleasant effects except a very disagreeable odor to the breath. In medicinal doses it slows and strengthens the heart, but in very large dosage it is paralyzant to both heart and respiration. It occasionally causes an erythematous eruption, and may give rise to cerebral congestion and vaso-motor paralysis, if used for any long period. Dose, ♏xxx–ʒj in water, syrup, etc.,—♏xl being about the average hypnotic dose.

***Hypnone,** $C_6H_5(CO)(CH_3)$, *Phenyl-methyl-acetone*,—a member of the Ketones, (see *ante*, page 132), occurring above 70° F. as a colorless, mobile liquid, having a strong almond and orange odor. It is insoluble in water or glycerin, and is best given in capsules. It is a hypnotic, of only moderate intensity, but said to be especially useful in the insomnia of alcoholism. Its use is devoid of danger, and leaves behind no unpleasant effects, except a disagreeable odor of the breath, the drug being eliminated by the lungs as well as by the kidneys. In very large dosage it has induced coma, followed by paralysis of the heart and respiration. Dose, ♏v–x, in capsule, ♏vij to ♏viij being usually required.

***Amylene Hydrate,** $C_5H_{12}O$, *Di-methyl-ethyl-carbinol*,—a tertiary alcohol, occurring as a clear, colorless fluid, of peculiar odor, soluble in 8 of water and readily miscible with alcohol. It is one of the most valuable hypnotics, in power standing between chloral and paraldehyde, but being much more agreeable to the taste and safer than either of those agents. Its action is exerted chiefly on the cerebrum in doses sufficient to produce profound narcosis; and in medicinal doses it leaves behind no unpleasant effects, and has no perceptible influence on the heart or respiration. By very large dosage the medullary centres are paralyzed, including those governing respiration and cardiac action. Dose, ʒj–ʒjss.

***Urethane,** $NH_2CO_2C_2H_5$, *Ethyl Carbamate*,—occurs in crystals which are readily soluble in water, with scarcely any taste or odor. It is devoid of irritant action, and may be administered hypodermically. It is a pure hypnotic, but not so reliable as paraldehyde or chloral; neither does it affect the circulation nor depress (but rather stimulates) the respiration. It acts directly on the cerebrum, causing a sleep which closely resembles the normal, and has no unpleasant after-effects. In very large doses it slows the heart, lowers the temperature, and induces muscular resolution and general anæsthesia. In small animals it effectually antagonizes the action of Strychnine. Dose, gr. xv–ʒj, an average hypnotic dose being gr. xxx; but it is best given in 5-grain doses repeated frequently, as a large dose may cause vomiting.

***Methylal,** $CH_2(OCH_3)_2$, *Methylene-di-methyl Ether*,—one of the products of the oxidation of Methylic Alcohol, occurring as a volatile, mobile liquid of pleasant, aromatic odor and taste, readily soluble in water, alcohol, etc. It is a local anæsthetic, and an efficient hypnotic, producing a deep sleep of short duration, with more or less general anæsthesia and lowered reflex excitability. It is depressant to the heart, respiration and body-temperature, but in medicinal doses does not leave any bad after-effects. Dose, *per orem*, ♏iv–v, repeated thrice at short intervals.

***Hyoscinæ Hydrobromas**, *Hydrobromate of Hyoscine*,—(see *ante*, page 116)—is an efficient hypnotic, with the advantage of being tasteless, and having a very small dose, (gr. $\frac{1}{60}$), so that it may be given in tea, coffee, etc. It is apt to affect the head afterwards, and soon loses its power by repetition. In large doses it is a dangerous respiratory depressant.

***Cannabini Tannas**, *Tannate of Cannabin*,—(see *ante*, page 122),—is not more reliable than the Extract of Cannabis Indica, though devoid of the exciting qualities of the latter preparation. Dose, as a hypnotic, gr. ij–x, the average being gr. v. Fronmüller considers it a very useful hypnotic, powerful and not dangerous, not disturbing the secretions, nor leaving unpleasant after-effects, if used in proper doses.

Physiological Actions of Chloral. It is essentially a hypnotic, also a depressor of the cerebro-spinal centres, antispasmodic, antiseptic, antiferment, counter-irritant, and prevents the coagulation of fibrin. It is more hypnotic than Chloroform, and less anæsthetic. Used hypodermically it is actively irritant, and produces extensive sloughing of the tissues.

The taste of Chloral is hot and pungent; if used in large doses or in strong solutions it may excite gastritis, with nausea and vomiting. After a brief period of stimulation it depresses the heart and arterial tension, diminishes oxidation, and lowers the body temperature. On the brain it has a selective action; by inducing cerebral anæmia it produces a deep sopor, very like normal sleep, from which the patient may be awakened but immediately falls asleep again, and is not followed by headache or depression. In some persons instead of sleep it causes headache, insomnia and delirious excitement. It is not an anodyne, as it does not affect the conductivity of the sensory nerves, and does not interrupt the transmission of pain, but by overwhelming the centres prevents the consciousness of pain, and is, therefore, only indirectly an anæsthetic.

A Large Dose produces profound narcotism, abolishment of the reflexes and of sensibility, and complete muscular relaxation, with a great fall of temperature. Death may result in the chloral sleep, from paralysis of the cardiac motor ganglia and the respiratory centre, or by sudden failure of the heart in cases of fatty degeneration, or in old drunkards.

The Chloral Habit. Chloralism is a state of marked anæmia, its subjects presenting a weak, irritable, often irregular heart, deranged liver function, jaundice, bileless stools, perhaps purpura and sloughing of a finger, from decreased blood supply. Its votaries are on the border of insanity, excitable, uncontrollable in speech and action, talking in a silly manner and very volubly. Many cases of insanity result from the chloral habit.

Action of Chloral on the Blood. It diffuses rapidly into the blood, which, being an alkaline fluid, partially decomposes it, setting Chloroform free (?). It crenates the red corpuscles, and in large quantities destroys the leucocytes. It increases the fluidity of the blood, producing an anæmic condition. It is excreted by the kidneys, partly unchanged, but chiefly as Uro-chloralic Acid, producing some diuresis;—also by the skin, causing various eruptions if long used.

Toxicology of Chloral. *Atropine* antagonizes its cardiac, respiratory and spinal depression, and should be given in small doses, frequently repeated, until its effects are apparent. *Morphine* given with chloral prevents the tendency to cardiac failure, while synergistic to its hypnotism. *Chloral* is the antagonist to *Strychnine*, opposing the spinal action of that drug, but the reverse is only true to a limited extent. Chloral and Atropine, though antagonistic in their actions upon the spinal cord, both produce motor paralysis,—the former by paralyzing the cord, the latter by paralyzing the motor nerves.

Therapeutics. Chloral is of great value as an hypnotic and antispasmodic, but must be cautiously used, if at all, in old drunkards or persons with weak or fatty hearts, atheromatous vessels, or advanced pulmonary disease. In combination with Potassium Bromide it is much used in asylum practice, and much abused; both drugs are cardiac poisons. It should never be given internally to relieve pain, but it is highly serviceable in—

Neuralgia,—if triturated with Camphor and applied locally.

Sea-sickness,—gr.v two or three times a day, generally very efficient.

Cholera in the algid stage, and in violent cases of cholera morbus,—gr. xv hypodermically every hour, of extraordinary efficacy.

Fevers, when high temperature, excitement, restlessness, and sthenic condition,—Chloral lowers the temperature, prevents the coagulation of fibrin, and is frequently of great utility.

Diphtheria,—Chloral in the first stage, but not if weak heart.

Obstetrics,—it is used to alleviate suffering, to relax the os uteri, to palliate puerperal convulsions, and to relieve after-pains.

Delirium Tremens,—Chloral has been too much used. It produces the best sleep in this condition, but is dangerous to old drunkards.

Tetanus,—the best treatment is by Chloral and Potassium Bromide.

Cancers and Ulcers,—a 25 per cent. solution locally, as an antiseptic and anodyne application.

Tic-douloureux,—Croton-chloral is an efficient palliative, given in 5-grain doses every half hour, up to gr. xxx.

Epilepsy,—for nocturnal attacks give Chloral in a full dose, at bedtime.

Strychnine Poisoning,—Chloral is the antagonist *par excellence*.

OPIUM,—Opium.

Nature and Source. The concrete, milky exudation, obtained in Asia Minor by incising the unripe capsules of *Papaver somniferum*, the white Poppy, an annual herb of the nat. ord. Papaveraceæ. In its normal, moist condition, it should yield not less than 9 per cent. of Morphine, when assayed by the official process. It contains 17 alkaloids, 2 neutral bodies, 2 organic acids,—also wax, gum, sugar, resin, extractives, odorous principles, etc. The six principal alkaloids of Opium are—

Morphina, Morphine, Dose, gr. 1/20–½;—hypnotic, anodyne and narcotic.

Codeina, Codeine, Dose, gr. ⅛–j;—calmative, and less constipating.

**Thebaina*, Thebaine,—a tetanizer; not used medicinally.

**Narceina*, Narceine, gr. ⅛–½;—probably the most hypnotic of the six.

**Papaverina*, Papaverine;—action doubtful, narcotic and convulsant (?).

**Narcotina*, Narcotine, Dose, gr. j–v;—wrongly named, having no narcotic action; is a tetanizer and highly antiperiodic.

A Derivative of Morphine, obtained by the action of HCl acid, is—

Apomorphina, Apomorphine,—an artificial alkaloid and a powerful emetic; the *Hydrochlorate* of which is official, and may be administered in doses of gr. ⅛ by stomach, or gr. 1/16 hypodermically.

These principles are combined in the plant with *Meconic* and *Lactic Acids*.

Preparations of Opium. The principal are—

Pulvis Opii, Powdered Opium. Dose, gr. ¼–ij;—gr. j is a medium dose.

Opium Denarcotisatum, Denarcotized Opium. Dose, gr. ¼–ij.

Extractum Opii,—an aqueous extract, containing Glycerin. Dose, gr. ¼–j.

Tinctura Opii, Laudanum,—♏xj or gtt. xxij about equal gr. j of Opium.

Tinctura Opii Deodorata,—♏ xj or gtt. xv about equal gr. j of Opium.

Vinum Opii, Sydenham's Laudanum,—♏xj or gtt. xviij about = gr. j of O.

Acetum Opii, Black Drop,—♏xj or gtt. xvj about = gr. j of Opium.

Tinctura Opii Camphorata, Paregoric,—℥ss contains nearly gr. j; therefore it has only 1/20 the strength of the Tincture.

**Liquor Opii Compositus* (Squibb),—♏xj or gtt. xxij about = gr. j of Opium.

**Tinctura Opii Composita*, Squibb's Diarrhœa Mixture,—has of Tinct. Opii, Tinct. Capsici, Spt. Camphoræ, āā ℥j, Chloroformi Purif., ʒiij, Alcoholis

Fort., q. s. *ad* ℥v. Dose, for infants, gtt. j–x; for children, gtt. x–xxx; for adults, ʒj.

Emplastrum Opii,—Ext. of Opium, Burgundy Pitch and Lead Plaster.

Pilulæ Opii,—each pill has gr. j of Opium with gr. ¼ of Soap.

Pulvis Ipecacuanhæ et Opii, Dover's Powder,—Ipecac 1, Opium 1, Sugar of Milk 8 parts, triturated to a fine powder. Dose, gr. v–xv.

Tinctura Ipecacuanhæ et Opii, to represent Dover's Powder in a liquid form;—Tr. Opii Deod. 10 parts evaporated to 8½, Fl. Ext. Ipecac. 1, Dil. Alcohol *ad* 10. Dose, ♏v–xv.

Trochisci Glycyrrhizæ et Opii,—each troche has gr. 1/20 of Ext. Opii.

Preparations of the Alkaloids.

Morphina, Morphine,—Average dose gr. ¼–⅙, which about equals gr. j of Opium of medium Morphine strength.

Morphinæ Acetas,—soluble in 12 of water. Dose, gr. 1/20–gr. j.

Morphinæ Hydrochloras,—soluble in 24 of water. Dose, gr. 1/20–gr. j.

Morphinæ Sulphas,—soluble in 24 of water, contains about 80 per cent. of Morphine. Dose, gr. 1/20–gr. j, a medium adult dose being gr. ⅙.

Pulvis Morphinæ Compositus, Tully's Powder,—gr. x contains gr. ⅙ of Morphine Sulphate, with Camphor, Liquorice and Calcium Carbonate.

**Tinctura Chloroformi et Morphinæ*, (B. P.),—each 10-minim dose contains of Morphine Hydrochlorate, gr. 1/48, of Chloroform, ♏j¼, of Dilute HCN Acid, ♏⅝, with ether, alcohol, oil of peppermint, liquorice, treacle and syrup. Intended as a substitute for Chlorodyne, (see *ante*, page 138).

**Liquor Morphinæ Sulphatis*, Magendie's Solution,—has gr. xvj of Morphine Sulphate in ℥j of Distilled Water, or gr. ¼ in ♏vijss. Morphine in solution will change to Apomorphine if kept long.

**Liquor Morphiæ Sulphatis*, *U. S. P.*, 1870,—has gr. j of Morphine Sulphate to the ℥ of Distilled Water. Dose, ♏xxx–℥ss.

Codeina, Codeine,—soluble in 80 of water. Dose, gr. ¼–gr. ij; but gr. ⅙ has produced alarming symptoms in children.

U. S. Phar. 1880, Changes in Opium Preparations. The official dried Opium should now contain 12 to 16 per cent. of Morphine, instead of 10 per cent., as required by the Phar. of 1870. The liquid preparations, except Paregoric, are required to be of the uniform Opium strength of 10 per cent. by weight, making the Wine 2 per cent. weaker, the Acetum ⅓ weaker, and the others ½ stronger in Morphine than formerly. So that, if the former full anodyne dose of Tincture be taken at ♏xxiv, = gr. ¼ of Morph. Sulph., the corresponding dose under the new system will be ♏xvj.

Tests for Morphine. *Nitric Acid* produces a blood red, turning orange, then yellow, then disappearing. *Ferric Chloride* gives a rich blue with Morphine, a dark brown with Meconic Acid or any preparation of Opium. *Iodic Acid* liberates Iodine, which may be tested by starch.

Minimum Fatal dose of Opium. In a child one day old ♏ j of Laudanum was fatal; and in another aged nine months a few drops of Paregoric caused death. In the adult gr. $\frac{1}{6}$ of Morphine, or gr. iv of crude Opium have proved fatal.

Treatment of Opium Poisoning. The chief indications are—to evacuate the stomach, maintain respiration, and keep up the circulation. *Atropine* antagonizes its cerebral action, also its action on the pupil, respiration, heart and arterial tension (?); but if given too freely will endanger the case by substituting Belladonna narcosis for Opium narcosis. Gr. $\frac{1}{120}$, hypodermically, every 15 minutes, for three doses, is generally sufficient. [The antagonism between these two alkaloids is denied by high authority.] *Strychnine*, *Coffee*, *Caffeine* and *Cocaine* are also physiologically antagonistic to Morphine. *Faradization* of the chest muscles, cold affusion and artificial respiration are of great value. *Flagellation* is a very dangerous procedure, from the exhaustion produced; strong faradic currents are much more efficient. *Evacuation of the bladder* is important, to prevent reabsorption.

Physiological Actions. Opium is analgesic, hypnotic, diaphoretic, antispasmodic, narcotic, also a cardiac and respiratory depressant, after brief stimulation thereof.

In Medium Doses (gr. j),—it dries all the secretions, except those of the breasts and the skin, the latter being increased; produces dryness of the mouth and throat, arrest of the gastric secretion, retarded digestion and anorexia; stimulates the brain by increasing the blood supply; and does not affect the conductivity of the nerves. The action of the heart is increased, and the arterial tension raised; the pupil slightly contracted; the mind, at first stimulated, becomes calm; sleep follows, disturbed by dreams; and headache, constipation and some depression result.

In Full Doses (gr. v),—it arrests digestion; causes nausea and vomiting; greatly increases the sweat; prevents the conductivity of the nerves; depresses the heart and circulation, impairing oxidation and lowering temperature; contracts the pupil by stimulating the motor oculi; causes intense pruritus, especially of the nose; often retention of urine; and soon profound sopor (in some cases coma-vigil, delirium); leaving as after-effects nausea, depression, constipation, vertigo, anorexia, nasal pruritus, fetid pathological secretions.

A Toxic Dose—produces cold, clammy sweat, very slow heart, abolished reflexes, coma; the pupil minutely contracted, but dilated as the end approaches; and death by suspension of respiration, due to the direct action of the poison on the respiratory centres in the medulla.

Post-mortem shows only a wet brain, congested lungs, and engorgement of the venous trunks and the right side of the heart.

Morphine and Codeine. As compared with the action of Opium, that of *Morphine* is more anodyne and hypnotic. It causes more intense pruritus, is less stimulant, less convulsant, less constipating and less diaphoretic. *Codeine* may chemically be considered a Methyl-morphine, and like all methyl compounds, has an action like that of Curare, viz.,—a motor-paralyzant. It exalts the spinal cord more than Morphine, and affects the cerebrum less, producing muscular tremor in excess of sedation. It reduces the urinary sugar in diabetes, and has a selective sedative influence on the pneumogastric.

Therapeutics. The chief indications for the use of Opium are—(1) to relieve pain; (2) to produce sleep; (3) to allay irritation; (4) to check excessive secretions; (5) to support the system; (6) as a sudorific. It is badly borne usually by women and children, and in some persons great nausea and depression follow its use, which may usually be averted by the conjoined administration of Potassium Bromide, Hydrobromic Acid, or Spirit of Ether, with each dose of the opiate used. It is especially valuable in—

Pain from any cause except acute inflammation of the brain.

Low Fevers when insomnia and low muttering delirium, and to support the system when sufficient food cannot be taken or retained.

Irritation of the bronchi, bladder, stomach, as in acute severe vomiting.

Peritonitis,—used freely, even to narcotism, it has often saved life.

Diarrhœa, Dysentery, Enteritis, etc.,—it is a very efficient remedy.

Acute Uræmia,—Loomis urges its use to control convulsions and promote diuresis; large doses required in this condition.

Colds and Muscular Rheumatism,—Dover's powder as a diaphoretic, conjoined with hot drinks and hot foot-baths.

Gastralgia,—no remedy equal to Morphine and Bismuth Subnitrate.

Colic,—rectal suppositories containing the Aqueous Extract of Opium.

Spasm,—Morphine hypodermically in muscular spasm, is efficient.

Cholera Morbus and Dysentery,—gr. $\frac{1}{12}$ of Morphine with gr. $\frac{1}{120}$ of Atropine, promptly effective after the ingesta have been removed by an active cathartic.

Serous Inflammation,—the Deodorized Tincture to slight narcotism.

Cerebro-spinal Meningitis,—Opium the one remedy if given early, before exudation has set in.

Superficial Inflammations,—Opium or Morphine locally, of great value.

Diabetes Mellitus,—Codeine or Morphine *per orem* reduce the sugar promptly, but have little or no effect when used hypodermically, even in the same case. (J. Mitchell Bruce.)

Dyspnœa from any cause is relieved by Morphine, especially that of cardiac disease. "It gives the power to breathe" (Huchard).

Cardiac Disease, especially aortic stenosis or insufficiency, with dyspnœa, paroxysms of angina pectoris, or signs of cerebral anæmia,—Morphine hypodermically presents the greatest advantages.

Hemorrhages, especially uterine, due to fibroids or cancer,—the influence of Opium on the circulation is invaluable.

Contraindications for the use of Opium are—alcoholism, disease of the respiratory organs, advanced disease of the kidneys, and some forms of cerebral congestion and cardiac disease.

HUMULUS,—Hops.

Source and Composition. The strobiles (fruit-cones) of *Humulus Lupulus,* the hop vine, a cultivated, climbing plant of the nat. ord. Urticaceæ. The glandular powder of the strobiles is also official, under the name *Lupulinum* (Lupulin); and contains a *Volatile Oil* and a resin; a liquid, volatile alkaloid, *Lupuline;* and Lupulinic Acid. The Volatile Oil is composed of *Trimethylamine* and *Valerol,* the latter being changed into Valerianic Acid by long exposure, giving a disagreeable odor to old hops. A narcotic alkaloid, named *Hopeine,* was recently said to have been discovered in hops, but has not been verified by other investigators.

Preparations.

Tinctura Humuli, Tincture of Humulus,—Dose, ʒss–℥ss.

Lupulinum, Lupulin,—a bright-yellow powder,—Dose, gr. ij–xv.

Extractum Lupulini Fluidum,—alcoholic,—Dose, ♏x–xxx.

Oleoresina Lupulini, Oleoresin of Lupulin,—Dose, gr. ij–x.

**Infusum Lupuli,* Infusion of Hop, (B. P.),—Dose, ℥j–ij.

Physiological Actions. Humulus is a bitter tonic, a feeble hypnotic, also diaphoretic, anaphrodisiac and astringent. It increases the cardiac action and the cutaneous circulation. After slight cerebral excitement it produces calm, and a soporific disposition.

Therapeutics. It is used as a tonic and calmative in—

Delirium Tremens of mild form,—a mixture of the fluid extracts of Lupulin and Capsicum is very efficient, and an excellent substitute for Alcohol.

Dyspepsia, of atonic form—Humulus is a very serviceable remedy.

Inflammation,—a hop poultice is a favorite domestic application.

Nervous Irritability,—The Fluid Extract of Lupulin as a calmative and hypnotic; or the Hop pillow, which exercises considerable influence.

LACTUCARIUM,—Lettuce.

Source and Composition. The concrete juice of *Lactuca virosa,* the acrid lettuce, nat. ord. Compositæ. It contains *Lactucin,* a bitter principle; *Lactucerin,* a neutral substance; *Lactucic Acid,* and other unimportant substances. It is partly soluble in alcohol and ether, and when triturated with water it yields a turbid mixture. Dose, gr. v–xxx.

Preparations.

Extr. Lactucarii Fluidum, ♏x–ʒj. *Syrupus Lactucarii,* ʒj–℥j.

Physiological Actions. Lactucarium is feebly hypnotic, sedative and diuretic. It is supposed to act similarly to Opium, but much more feebly, and without depressing after-symptoms.

Therapeutics. It is used as a substitute for Opium, and as a remedy for cough. The syrup is best employed as a vehicle for more active agents of the same class.

BROMINE,—BROMIDES.

Bromine, (Bromum),—is a liquid, non-metallic element, having the symbol *Br.*, obtained from sea-water and from certain saline springs; a dark, brownish-red, very volatile liquid, of strong and disagreeable odor. Its solution colors cold starch-water yellow. [*Iodine* colors it blue.] Bromine is only used by inhalation and locally as an escharotic.

Bromides and their Preparations.

Potassii Bromidum, Bromide of Potassium, KBr,—colorless, cubical crystals, soluble in 1.6 of water, and in 200 of alcohol. Dose, gr. v–ʒj.

Sodii Bromidum, Bromide of Sodium, NaBr,—colorless, monoclinic crystals, soluble in 1.2 of water, and in 13 of alcohol. Dose, gr. v–ʒj.

Lithii Bromidum, Bromide of Lithium, LiBr,—a white, granular, deliquescent salt, very soluble in water and in alcohol. Dose, gr. v–xx.

Ammonii Bromidum, Bromide of Ammonium, NH_4Br,—colorless, prismatic crystals, soluble in 1½ of water and in 150 of alcohol. Dose, gr. v–xx.

Calcii Bromidum, Bromide of Calcium, $CaBr_2$,—a white, granular, deliquescent salt, very soluble in water and in Alcohol. Dose, gr. v–ʒj.

Zinci Bromidum, Bromide of Zinc, $ZnBr_2$,—a white, granular, deliquescent powder, very soluble in water and in alcohol. Dose, gr. ss–ij.

**Arsenii Bromidum,* Bromide of Arsenic,—or *Bromi Arsenis,* Arsenite of Bromine,—described under Arsenic, (see ante, page 57.)

Camphora Monobromata, Monobromated Camphor, Bromide of Camphor,—described under Camphor, (see ante, page 117.)

Syrupus Ferri Bromidi, Syrup of Bromide of Iron,—contains 10 per cent. of Ferrous Bromide, $FeBr_2$,—Dose, ℥ ss–j.

Preparation of Hydrobromic Acid.

Acidum Hydrobromicum Dilutum, Diluted HBr Acid,—a clear, colorless, odorless liquid, containing 10 per cent. of absolute HBr. Introduced into medicine as a substitute for the Bromides. Dose, ♏x–ʒ ij.

Physiological Actions of Bromine. It is an active and painful escharotic, a deodorant and an antiseptic, setting free ozone. Internally, it is a corrosive poison, producing violent gastritis, depression and collapse. Its vapor is highly irritant to the respiratory mucous membrane.

Physiological Actions of the Bromides. They are pre-eminently depressants of the cerebral and spinal functions, also alterative, antispasmodic and hypnotic. The Potassium salt is especially a cardiac and muscular paralyzant.

The Bromides have a saline taste, and are very diffusible, but slowly eliminated. They are decomposed in the blood, and reformed at the points of elimination (fauces, bronchi, intestines, skin and kidneys), where they irritate the mucous membranes. Continued for some time, they produce severe gastric catarrh. They reduce the number of the respirations, and the heart's action and force; and though diminishing the calibre of the arterioles, they lower arterial tension. They lessen the activity of the brain cells, producing somnolence; diminish the sensibility of the peripheral nerves, causing anæsthesia of the skin and mucous membranes. They impair motility and the sexual function, cause great pallor and emaciation, lowered body-temperature, acne on the face and upper extremities, fetid breath, dysphagia, sluggish reflexes and defective coördination; and if long continued may even impair the mental faculties, producing hallucinations in some cases, in others melancholia with suicidal tendency; also incompetence of the sphincters and paralysis, beginning at the periphery and extending to the centres.

The general result of their action is termed "Bromism," and is heralded by the acne and lowered faucial sensibility. It is probably due to the sedative influence of these agents on the sympathetic system, causing general anæmia of the brain, spinal cord, sexual organs, and skin.

Differences in Action between the several Bromides.

Potassium Bromide is the most toxic to the heart and the muscular system, and is the least hypnotic. It contains 66 per cent. of Bromine.

Sodium Bromide is the least toxic, but the most hypnotic, and acts most energetically on the circulation. It contains 78 per cent. of Bromine.

Ammonium Bromide resembles the Potassium salt in action, except that it exerts less influence on the heart and muscular system, and is somewhat more stimulating.

Lithium Bromide contains the most Bromide (92 per cent.), and resembles the Sodium salt in action. It has proved better than the others in some cases of epilepsy, and is considered the best hypnotic of the series.

Calcium Bromide is an efficient hypnotic, but otherwise not very active.

Bromide of Zinc produces effects generally similar to those of the other bromides, but in large doses is violently irritant.

Ferrous Bromide is official only in the Syrup. It is supposed to combine the actions of Iron and those of the Bromides, and to produce the effects of a sedative chalybeate tonic.

Antagonists and Incompatibles. Vaso-motor stimulants, as Digitalis, Ergot, Belladonna, antagonize many of the effects of the Bromides, but *Morphine* is the most efficient antagonist, especially for the mental symptoms. Nitrous Ether is incompatible with the Bromide of Ammonium, and Acids and metallic salts are so with all the Bromides.

Therapeutics. The Bromides are used as sedatives to the nervous system, to lower reflex activity, to produce sleep, to subdue excitement of the genital apparatus, and to antagonize congestion of the brain. Their use is terribly abused, by patients, nurses, and even by physicians,—as Dr. Hammond well elucidates in the last chapter of his book on Nervous Diseases. They should not be used in anæmic conditions, and never for any length of time without the daily supervision of a physician. The combination of Potassium Bromide with Chloral is very unsafe in cases where fatty or weak heart exists, both drugs being active cardiac depressants. In—

Convulsive and Spasmodic Affections,—the Bromides are very efficient.

Epilepsy, especially diurnal seizures, the Bromide of Sodium in sufficient quantity to maintain anæsthesia of the fauces, for three or four years. Purgation occasionally, to prevent its accumulation in the system, and Arsenic to antagonize the acne.

Diabetes Mellitus,—the Bromides of Ammonium and Arsenic in cases of nervous origin, have proved curative when long used, by their sedative influence on the medulla oblongata.

Acute Rheumatism,—the Bromide of Ammonium is an excellent alkali.

Muscular Rheumatism,—the Lithium salt gives very good results.

Nervous Erethism,—the Bromides are much used, and with good effect.

Insomnia with congestion, as from cerebral overwork.

Infantile Colic,—the Bromide of Sodium, in five-grain doses, with a little Oil of Anise, is considered excellent.

Cholera Infantum,—the Bromides check the vomiting and purging.

Vomiting of cerebral origin,—they are extremely useful.

Cardiac Irritability, when not due to anæmia, is calmed by the Bromides.

Delirium Tremens. In the preceding "horrors," half drachm doses of the Potassium salt every four to six hours, are often very efficient;—but their effects must be closely watched, as they are liable to suddenly paralyze the cardiac muscle in alcoholic subjects.

Melancholia,—occasionally the Bromides give great relief.

Whooping-cough, and other reflex coughs,—the Bromides as palliatives;—or the dilute Hydrobromic Acid in a cough-mixture.

Seminal Losses, if plethora exists,—are well treated by Bromides.

Nymphomania,—these agents have almost a unique power.

Tetanus,—Potassium Bromide is antagonistic in large doses.

Subinvolution of the Womb, and Menorrhagia,—the Potassium salt is considered to have specific power thereon.

Therapeutics of Bromine. It is not much used. In—

Chancre, Hospital Gangrene, etc.,—Bromine locally is the best escharotic.

Diphtheria and Membranous Croup,—a solution containing 8 drops to the ℥, used internally, and inhalations of the vapor, have been used successfully in the most severe cases.

Hydrobromic Acid may be used as an alternate substitute for the Bromides in most all their affections, except epilepsy. In—

Neurasthenia and post-hemiplegic convulsions,—it should entirely supersede the Bromides, being more efficient in these conditions.

Coughs of spasmodic and reflex character,—it is excellent, but is best employed in conjunction with other remedies.

Tinnitus Aurium and similar subjective noises, whether due to Quinine or Salicylates or not,—are removed by this acid.

In Quinine Solutions, ♏ij to each grain,—it aids the solubility, and neutralizes the effects of the alkaloid upon the ears.

Cerebral Disturbances of continued fevers,—it does good service;—also in subjective cerebral symptoms, as "swimming of the head," etc.

MOTOR DEPRESSANTS.

CONIUM,—Hemlock.

Source and Composition. The full-grown fruit of *Conium maculatum*, the Spotted Hemlock, (nat. ord. Umbelliferæ), gathered while yet green. It contains a liquid, volatile alkaloid, *Coniine*,—also *Methyl-coniine* in varying proportion,—a solid alkaloid, *Conhydrine*,—a volatile oil, and *Coniic Acid.*

Preparations. The Extracts are usually inert.

Abstractum Conii, Abstract of Conium,—Dose, gr. ss.–gr. v.

Extractum Conii Alcoholicum, Alcoholic Extr. of Conium,—Dose, gr. j–iij.

Extractum Conii Fluidum, ♏v–xv. *Tinctura Conii*,—Dose, ♏xx–ʒj.

All Conium preparations are uncertain, the active principle being very volatile. Each sample should be tested before fixing on its dose, and should have the characteristic mouse-like odor.

**Coniïna*, Coniïne, $C_8H_{15}N$, the active alkaloid,—Dose, ♏$\frac{1}{10}$–iij, or gr. $\frac{1}{60}$–$\frac{1}{10}$. If given hypodermically, it must be neutralized by acetic acid, as shown by the use of litmus paper, otherwise it is too irritant; or the *Hydrobromate* in solution, gr. viij ad ℥j,—of this ♏x = gr. 1/6. This salt may be used in doses of gr. $\frac{1}{12}$–gr. j, as it is not actively toxic.

**Methyl-Coniïne*, $C_8H_{14}NCH_3$,—affects the action of the plant, but is not used in medicine.

Physiological Actions. Conium is a gastric irritant, producing nausea and vomiting. The main action of *Coniïne* is that of a paralyzant to the motor nervous system, beginning at the peripheral end-organs and extending upwards, involving the nerve trunks, and finally the centres. *Methyl-coniïne* acts similarly but reversely, affecting the centres first; especially those in the spinal cord, causing paralysis of reflex action. Conium also blunts the common sensibility. Its prominent symptoms are—numbness and weakness of the legs, drooping eyelids, diplopia, slightly dilated pupils, vertigo, impaired utterance, slow and labored breathing, and death by paralysis of the muscles of respiration. The heart is not affected; and the mind is clear until CO_2 narcosis sets in, but is torpid and indifferent.

Socrates was poisoned by the juice of Conium, which was the state poison of the Athenians.

As the action of Coniïne and Methyl-coniïne vary considerably, and as the relative quantity of each alkaloid in the plant also varies, the results obtained from different samples of Conium differ in marked degree, and are often contradictory of each other.

Physiological Antagonists. *Nux Vomica* and its alkaloids, also *Picrotoxin*, and other tetanizers. Active exercise will hinder its toxic action from being fully developed.

Therapeutics. Conium is used as a sedative to pain and to correct excessive motility. Large doses are required, as some physiological action is necessary. Children bear it well. In—

Chorea, it palliates by depressing the motor nervous system.

Whooping-cough and other spasmodic affections,—it is useful.

Acute Mania,—to quiet motor excitement and prevent exhaustion. Coniïne, ♏ss–iij, or hypodermically, ♏$\frac{1}{10}$, increased until some physiological effects are produced. Morphine given conjointly acts well.

Pain and Spasm coexisting,—are well met by Conium.

Cancer,—Conium is used locally and internally, to relieve the pain.

Tetanus,—for its sedative action, Conium has been much used, but is inefficient.

Blepharospasm is relieved by it, in 10-minim doses of the fluid extract.

Epilepsy, *Hysteria*, *Hystero-epilepsy*, and most convulsive disorders,—it is of decided value, and can be given without fear of inducing a habit.

GELSEMIUM,—Yellow Jasmine.

Source and Composition. The rhizome and rootlets of *Gelsemium sempervirens*, a climbing plant of the nat. ord. Loganiaceæ, indigenous in the Southern States. It contains an alkaloid, *Gelsemine*, in combination with Gelsemic Acid, also a volatile oil, and a resin. Dose, gr. ij–xx.

Preparations. Only two are official, viz.—

Tinctura Gelsemii, ♏x–ʒj. *Extractum Gelsemii Fluidum*, ♏ij–xxx.

* *Gelsemina*, Gelsemine, with acids forms soluble salts; gr. $\frac{1}{60}$–$\frac{1}{20}$.

Antagonists. *Opium* is the antagonist. Artificial respiration and faradism of the muscles of respiration are measures of prime importance in poisoning by this drug.

Physiological Actions. Gelsemium is an antispasmodic, a diaphoretic and nervous depressant, paralyzing motility and sensibility by central action on the spinal cord. It is also anaphrodisiac.

In Moderate Doses it causes languor, slowing of the cardiac rate, feebleness of muscular action, impaired sensibility, drooping eyelids and dilated pupils, with some diaphoresis.

A Toxic Dose (a teaspoonful of the fluid extract) produces vertigo, diplopia, drooped eyelids, dilated pupils (paralysis of 3d nerve), labored breathing, slow and feeble heart, dropped jaw, staggering gait, great muscular weakness and almost complete general anæsthesia, profuse sweats, loss of articulation, and death by asphyxia (paralysis of muscles of respiration). Consciousness is preserved until CO_2 narcosis sets in. Convulsions do not occur in man, but do in lower animals, the convulsive movements being backward. Motion is affected before sensibility in warm-blooded animals, sensibility before motion in frogs.

Gelsemium, though it lowers the heart rate, is not an arterial depressant, and does not irritate the gastro-intestinal tract. The effects of a moderate dose pass off in about three hours. It produces a decided lowering of the body temperature.

Therapeutics. Gelsemium is indicated in all conditions of exalted nerve function, and contra-indicated whenever there is weak heart. It is well used in—

Cerebro-spinal Meningitis,—♏v of the fluid extract every 2 hours.
Mania, with great motor excitement and persistent insomnia.
Delirium Tremens, and many forms of *Insomnia*,—it is very efficient.
Pneumonia and Pleuritis,—♏v–x of the fluid extract every 2 hours, to maintain a physiological effect, give excellent results. If the heart be weak this remedy must not be used.
Cough of convulsive or spasmodic character,—it is useful.
Neuralgia of the 5th Nerve has been successfully treated by Gelsemium.
Remittent Fever,—it usually exercises a very beneficial influence.
After-pains are frequently suspended by moderate doses.
Ovarian Neuralgia,—there is no better remedy, in full doses.
Dysmenorrhœa,—Gelsemium often greatly alleviates the pain.
Irritable Bladder of women, and incontinence of urine from spasm of the vesical muscular fibres,—this remedy is often very efficient.

*CURARE,—Woorara.

Source and Composition. Curare is a vegetable extract, obtained from various plants (Strychnos toxifera, Paullinia curara, etc.) of the nat. ord. Loganiaceæ, and used in S. America as an arrow poison. Its active principle is the alkaloid *Curarine*, which contains no oxygen. It contains no Strychnine, nor any tetanizing principle.

Preparations. There are none official.
**Curare*, gr. $\frac{1}{10}$ hypodermically; or ♏x–xv of a solution of gr. j in ʒij.
**Curarina*, Curarine, gr. $\frac{1}{200}$ hypodermically, gr. $\frac{1}{50}$ by stomach.
**Caroval*, *Vao*,—are names of native preparations.

Physiological Actions. Curare paralyzes the end-organs of the motor nerves, but does not at first act directly on the brain or spinal cord; though if life be prolonged by artificial respiration, the cord, sensory nerves, and even the muscular tissues become implicated. The limbs are paralyzed first, death occurring by paralysis of respiration. The heart, at first quickened, becomes depressed, the blood pressure lowered, the eyelids droop, the eyeballs protrude, vision is disordered, intestinal peristalsis and sensibility to stimuli are greatly increased, an artificial glycosuria (curare-diabetes) is set up, and all the secretions are increased, especially the saliva.

The absorption of Curare by the stomach is very slow, but its elimination which takes place by the kidneys, is more rapid and complete than that of any other alkaloid. The urine of a curarized animal will poison another, and that of the second animal will paralyze a third.

Actions of Curare, Coniïne and Gelsemine. Curare and Coniïne paralyze the end-organs of the motor nerves, Gelsemine and Methyl-Coniïne paralyze the motor centres.

Antagonists. Artificial respiration, to maintain life until elimination occurs. Evacuation of the bladder repeatedly is an important measure. *Strychnine*, though from a member of the same family, is antagonistic as to the effects on the heart and respiration.

Therapeutics. Curare is effective in—

Tetanus, both idiopathic and traumatic,—injections of gr. $\frac{1}{6}$–$\frac{1}{2}$, repeated hypodermically, have proved curative in many cases. In *Hydrophobia*, *Epilepsy* and *Chorea* it has apparently effected cures.

PILOCARPUS,—Jaborandi.

Source and Composition. The leaflets of *Pilocarpus pennatifolius*, a Brazilian plant of the nat. ord. Rutaceæ. It contains 2 alkaloids, *Pilocarpine* and *Jaborine*, which though isomeric are antagonistic in action;—also a volatile oil and probably a peculiar acid.

Preparations.

Extractum Pilocarpi Fluidum,—Dose ♏v–ʒj. Generally inert.

Pilocarpinæ Hydrochloras, gr. $\frac{1}{20}$–$\frac{1}{2}$. Hypodermically, gr. $\frac{1}{6}$ may be given.

Physiological Actions. Pilocarpus is a paralyzer of the vaso-motor system, and a stimulant of the peripheral terminations of nerves supplying glands and involuntary muscular fibre, subsequently paralyzing the latter. It is therefore a powerful diaphoretic and sialogogue, a cardiac depressant by stimulation of the vagus ends,—also myotic, emetic, and under some circumstances abortifacient. Its taste is hot and pungent. It causes prompt and profuse perspiration (℥ix–xv, in quantity) and salivation (℥x–xxvij), after a preliminary flushing of the skin. The nasal, bronchial and lachrymal secretions are much increased; sometimes watery diarrhœa occurs; the action of the heart, at first increased, is afterwards lowered, the arterial tension is reduced, and the temperature falls from 1° to 4°. Drowsiness, pallor, chilliness and debility succeed, and last several hours; the pupil is contracted and accommodation impaired. The elimination of urea is greatly increased, but not the quantity of urine. The respiratory power is lowered, and apnœa may occur, from increase of the bronchial mucus.

Pilocarpus is rapidly diffused, and is eliminated by the skin and the salivary glands. Its effects pass off usually in from three to six hours. Children are less affected than adults, by proportionate doses. It causes contractions of the bladder, uterus and spleen, in the latter case whether the organ is enlarged or of normal size.

Physiological Antagonist. *Atropine*, in dose of gr. $\frac{1}{100}$ for gr. $\frac{1}{8}$ of Pilocarpine; its antagonism is very complete throughout the whole range of action. Conversely *Pilocarpine* is exactly antagonistic to Atropine, but *Jaborine* acts similarly to the latter drug. *Morphine* controls the nausea and vomiting.

Therapeutics. Pilocarpus is well used in—

Ptyalism—a minute dose of Pilocarpine (gr. $\frac{1}{80}$) acting on the same gland will antagonize the morbid action and relieve the excessive secretion (Bartholow, Piffard). *Perspiration* of profuse character is checked by gr. $\frac{1}{20}$ of Pilocarpine given thrice daily (Ringer).

Diphtheria and Erysipelas,—are diseases in which it proves efficient, but in which its depressant action on the heart must be remembered.

Amblyopia from alcohol and tobacco, keratitis, choroiditis, chronic iritis, detached retina, and many other eye affections,—Pilocarpus is very beneficial.

Pleuritis, *Meningitis* and other inflammations of serous membranes,—it is remarkably efficient in removing exudations.

Dropsy is its chief field of action, especially renal dropsy; but it is contra-indicated when the heart is weak from any cause.

Diabetes Insipidus,—it reduces the quantity of urine remarkably, relieving the kidneys by throwing the work on the skin.

Agalactia,—Pilocarpus promptly stimulates the secretion of milk.

Uræmia, and Puerperal Eclampsia of renal origin,—it has been used with marked success. *Parotitis* is promptly relieved by it.

Bright's Disease,—Pilocarpine has been used with great advantage in both the acute and chronic forms, but is so depressing that it must be employed with extreme caution in this disorder.

* MUSCARINA,—Muscarine.

Source and Composition. It is an active toxic alkaloid of syrupy consistence, from *Agaricus muscarius*, or Amanita muscaria, the fly-agaric, a poisonous mushroom, used in Kamschatka as an intoxicant. The alkaloid is freely dissolved out by water and dilute acetic acid, so that a doubtful fungus may be easily rendered innocuous. Its formula is $C_5H_{15}NO_3$.

* *Muscarina*, Muscarine, gr. $\frac{1}{8}$–ij. **Muscarinæ Nitras*, gr. $\frac{1}{10}$–$\frac{1}{4}$.

Physiological Actions. Muscarine is a powerful respiratory and cardiac depressant, paralyzing the respiratory centre, and arresting the heart in diastole by paralyzing the cardiac muscle while stimulating its inhibitory apparatus. It lowers the arterial tension, produces profuse salivation and sweating; contracts the pulmonary vessels, causing intense dyspnœa; and increases the intestinal, hepatic and pancreatic secretions, but markedly diminishes the renal. It disturbs the gastro-intestinal tract, causing severe colic, vomiting and purging. It produces spasm of the accommodation, and marked myosis, contracting the pupil when given internally, but dilating the pupil widely when locally applied. (Gelsemium does so also.) Under its action the body-temperature is decidedly reduced, and the excretion of waste-products lessened.

On the cerebrum Agaricus acts as an intoxicant, producing more vertigo and delirium than Alcohol, followed by profound sopor with lowered reflexes, perhaps coma and death.

Physiological Antagonist. *Atropine* exactly opposes Muscarine, and *vice versâ*; no example of physiological antagonism being so complete in all particulars. When a frog's heart is arrested by the topical action of a minute quantity of Muscarine, the application of a little Atropine will immediately restore the pulsations (Ringer). An equally prompt antagonism runs through their entire spheres of action.

Therapeutics. Clinical experience with Muscarine is wanting. It has been used with considerable benefit in—

Night-sweats of Phthisis,—in which it is found extremely efficient.

Chorea,—Agaricus has proven a potent remedy in the idiopathic form.

Ataxic Typhus, with great restlessness and tremor, the tincture of Agaricus in drop-doses has often been effectively employed.

Chilblains have been cured by the same preparation, locally applied.

Inflammations characterized by copious exudation,—Muscarine promises to be of great service, especially in *Eye Inflammations* with exudation,—as it permits of the contraction or dilatation of the pupil at will, according as it is used internally or locally.

Constipation due to torpor of the intestines and deficient secretion, accompanied by a torpid liver and difficult digestion of fats,—Muscarine is exactly indicated in doses of gr. $\frac{1}{30}$ thrice daily.

Catarrhal Jaundice, and *Diabetes* of both forms,—are conditions in which Muscarine promises to be of especial service.

PHYSOSTIGMA,—Calabar Bean.

Source and Composition. The seeds of *Physostigma venenosum*, (nat. ord. Leguminosæ), a woody creeper of Calabar, West Africa, where it is used by the natives as an ordeal for witches, etc. It contains an alkaloid, which is variously named *Eserine*, *Calabarine* and *Physostigmine*,—also albuminous matters, starch and oil.

Preparations.

Tinctura Physostigmatis, ♏v–xx. *Extractum Physostigmatis*, gr. $\frac{1}{16}$–$\frac{1}{4}$.

Physostigminæ Salicylas, Salicylate of Physostigmine, gr. $\frac{1}{100}$–$\frac{1}{60}$.

**Lamellæ Physostigminæ*, Disks of Physostigmine (B. P.),—Medicated disks, used locally on the eye, each containing gr. $\frac{1}{1000}$.

Physiological Actions. Physostigma is a muscular stimulant and a direct spinal paralyzer, producing complete general paralysis, and abolishment of the reflexes, but does not affect muscular irritability or the brain. It stimulates secretion, excites nausea and vomiting; and is laxative by stimulating the muscular coat of the intestines, as well as by increasing the intestinal secretions. It first lowers, then raises the arterial tension; increases the heart-beat in frequency, but depresses the power of the cardiac muscle, though not destroying it. It produces dyspnœa by a tetanic action on the respiratory muscles, causing CO_2 poisoning, and death by paralysis of respiration. It contracts the pupils (how, is disputed) and the ciliary muscle, producing marked myosis. It is eliminated chiefly by the kidneys, the urine of the animal affected poisoning another.

Physiological Antagonists. *Atropine* as to the respiration, heart and pupil. *Chloral* is also antagonistic, but to be effective must be administered some time before the ingestion of the Physostigma.

Therapeutics. Physostigma has but a small field of action. In—

Constipation, due to torpor of the bowels,—combined with Belladonna and Nux Vomica, it is sometimes very effective.

Tetanus,—it has been used with great advantage to diminish reflex excitability; grain doses of the extract repeated every two hours.

Progressive Paralysis of the insane—this drug seems to retard it.

Strychnine and Atropine Poisoning,—Physostigma is antagonistic.

Eye Diseases,—Eserine is now used by ophthalmologists for almost every indication, just as a few years ago they used its exact antagonist—Atropine; a remarkable instance of the influence of fashion, as well as of the value of contraries. It is useful to break up or prevent adhesions of the iris, to relieve tension, to prevent suppuration after operations, as well as to contract the pupil and the vessels of the eye, thereby relieving pain and photophobia.

ACONITUM,—Aconite.

Source and Composition. The tuberous root of Aconitum Napellus, a perennial plant of the nat. ord. Ranunculaceæ, found in mountainous regions. Its active principle is the alkaloid *Aconitine*, which it contains in the proportion of .03 per cent., together with *Aconitic Acid.* Other varieties of Aconite are said to contain several other principles, concerning which the authorities are much divided, viz.—*Napelline*, *Aconine*, *Pseudaconitine*, *Lyctonine*, etc., but it is generally conceded that Aconitum ferox, from Nepaul, contains *Pseudaconitine*, which is much more active than Aconitine;—also that a Japanese variety contains an alkaloid which is more powerful than even Pseudaconitine.

Preparations.

Abstractum Aconiti, Abstract of Aconite,—Dose, gr. ⅛-j.

Extractum Aconiti Fluidum, ♏¼–♏ij. *Extractum Aconiti*, gr. ⅙–⅓.

Tinctura Aconiti, ♏ss–iv;—is of 40 per cent. aconite strength, and being a tincture of the root is many times more powerful than the former tincture of the leaves, which is still to be found in the shops. Fleming's Tincture has 79 per cent., the Br. 16, the French 20, the German 10; so that great care must be used not to mistake one for another.

* *Aconitina*, Aconitine—Dose, gr. $\frac{1}{200}$–$\frac{1}{50}$. Is difficult to obtain of constant strength, some samples being all but inert, others extremely active. The "Aconitine Cristalisée" of Duquesnel (a Nitrate of Aconitine, *Squibb*), is considered the most active of the samples in the market.

* *Aconitinæ Oleatum*, Oleate of Aconitine:—2 per cent. for external use.

* *St. Jacob's Oil* is a weak Aconite Liniment which also contains Ether, Alcohol, Turpentine, red coloring matter, and Water (*Squibb*).

Physiological Actions. Aconite is a powerful sensory, cardiac, respiratory, and spinal depressant, also diaphoretic, diuretic and antipyretic. It chiefly affects the peripheral ends of the sensory nerves, but paralyzes both motor and sensory nerves,—the sensory being affected first and from the periphery inwards, while the motor nerves are affected from the centres outwards. It relaxes the inhibitory apparatus of the heart, and paralyzes the cardiac muscle and its contained ganglia, the respiratory centres and the spinal cord in all its functions, (sensory, reflex and motor), but does not affect the brain. The taste of Aconite is bitter, acrid and pungent. Soon after the ingestion of even a small quantity, a sensation of numbness and a persistent tingling are felt in the tongue and lips. Full medicinal doses cause a sense of constriction in the fauces, irritation of the gastro-intestinal mucous membrane, with increased secretion; sometimes nausea and vomiting, and severe pains in the joints and muscles; always more or less salivation, diaphoresis and diuresis, reduced respiratory power, decreased cardiac rate and force, lowered arterial tension and temperature.

A Lethal Dose produces great muscular weakness, dimness of sight, dilated (sometimes contracted) pupils, shallow, irregular and labored respiration, a slow and weak pulse, coldness of the surface, clammy sweat, great anxiety, numbness and tingling in the extremities; lowering of the body temperature (2° to 3°), abolishment of sensation, reflexes and motility; and finally death from paralysis of the heart and respiration, with or without convulsions, consciousness being preserved until near the end, when CO_2 narcosis sets in.

Aconite is rapidly diffused and slowly excreted; the effects of a full medicinal dose continuing for three or four hours. Applied externally it paralyzes the sensory nerves of the part, producing its characteristic numbness and tingling.

Physiological Antagonists. *Atropine*, *Morphine* and *Ammonia* antagonize its effects on the heart and respiration. *Digitalis* counteracts its heart action and the relaxation of cardiac inhibition. (See *ante*, page 104.) In Aconite poisoning, the stomach should be evacuated, warmth applied to the extremities, stimulants administered, artificial respiration if necessary, and the recumbent posture strictly maintained.

Therapeutics. Aconite antagonizes the fever process, and rightly used is, therefore, one of the most valuable drugs we possess. It has been called the "therapeutic lancet," and certainly is responsible to a great extent for the disuse into which venesection has fallen. Its power over the circulation, respiration and transpiration render it of the greatest value in all affections characterized by high resisting pulse, dry, hot skin, and elevated body-temperature. It is especially useful in—

Acute Throat Affections, as tonsillitis, pharyngitis, etc.—drop-doses of the tincture every hour are remarkably efficient in these conditions.

Acute Inflammations of the Respiratory Organs, as bronchitis, coryza, pneumonia, etc.,—Aconite is efficient in the early stage, when there is present a sthenic febrile action, with high temperature.

Acute Pleuritis and Peritonitis, previous to the stage of effusion,—Aconite combined with Opium is considered to be the best treatment.

Simple and Eruptive Fevers, particularly scarlet fever and measles,—are best treated by small repeated doses of Aconite, which in measles is particularly efficient from its power to arrest the catarrhal pneumonia.

Puerperal Fever,—Aconite steadily used, with an occasional dose of Castor Oil, is one of the best agents in the metritis form of this disease.

Surgical Fever is promptly met by Aconite, which is especially useful in preventing chill after the passage of the urethral sound or catheter.

Erysipelas Faciei,—Aconite is highly serviceable, and usually curative.

Acute Rheumatism has been extensively treated with Aconite, and always with the best results. It lessens the duration of the fever, mitigates the pain and swelling of the joints, and prevents the occurrence of organic heart disease, if used from the commencement. (Phillips.)

Cardiac Affections characterized by over-action or hypertrophy, without valvular lesion, are benefited by Aconite in small doses repeated.

Diarrhœa and Dysentery, from cold or exposure,—Aconite is unquestionably beneficial. It also relieves *Constipation* in patients of plethoric habit, with dry, hot skin, and a feverish tendency.

Menstrual Suppression from chill,—Aconite often relieves promptly.

Neuralgia, especially of the face or brow,—Aconite is very efficient, having a selective influence on the 5th nerve. It may be used internally and also applied locally over the seat of pain; for the latter purpose a reliable *Aconitine* should be used, mixed with Chloroform and Oleic Acid, the Chloroform aiding the inward osmosis of the drug.

PULSATILLA,—Pasque-flower.

Source and Composition. Pulsatilla is the herb, collected soon after flowering, of *Anemone Pulsatilla*, *Anemone pratensis*, and *Anemone patens*, var. *Nuttalliana*, small plants of the same natural order as Aconite, (Ranunculaceæ); the first two being indigenous to Europe and Siberia, the third being a native of the United States. All are inodorous, very acrid, and contain an acrid, oily principle, which with age separates into *Anemonin*, a volatile camphoraceous principle, and *Anemonic Acid*, which seems to be inert.

Preparations. The herb is alone official, but a tincture may be made according to the pharmacopœial directions for Tinctures of Fresh Herbs, consisting of equal parts of the juice and alcohol, which may be used in doses of ♏ $\frac{1}{10}$–x.

* *Anemoninum*, Anemonin,—Dose, gr. $\frac{1}{10}$–ij, in pill.

Physiological Actions. Pulsatilla is a paralyzer of motion and sensation, a gastro-intestinal and cutaneous irritant, a cardiac, respiratory, and spinal depressant. It dilates the pupil, and produces diaphoresis and diuresis. Locally applied it produces numbness and tingling in the part, and may even excite violent inflammation. Its action is due to *Anemonin*, and strongly resembles that of Aconite.

Therapeutics. Pulsatilla is a very efficient drug if a fresh preparation be employed. It is excellent in—

Uterine Affections, as functional amenorrhœa, dysmenorrhœa, suppression of the menses from fright or chill and leucorrhœal discharges.

Epididymitis is often controlled and dissipated by a very small dose of Pulsatilla,—a few drops of the tincture in a glass of water, and of this a teaspoonful every two hours (Piffard).

Dyspepsia, or sub-acute gastritis, with white-coated tongue, no taste or a greasy sensation in the palate, nausea, flatulence, heartburn, etc.,—Pulsatilla in 5-drop doses of the tincture every four hours.

Coryza, *Otitis*, *Rhinitis*, *Conjunctivitis*, and other inflammations of mucous membranes with mucous or muco-purulent discharge,—Pulsatilla internally and locally (ʒj–ij of the tincture to ℥iv aquæ as lotion).

Coughs of irritative character, whooping cough, etc.,—Anemonin in doses of gr. ss–j has been found very useful.

Tape-worm,—an extract of the root has proved an efficient tæniafuge.

Cutaneous Affections, especially the eczematous forms, ulcers of indolent character, and syphilitic eruptions,—Pulsatilla locally and internally.

Acute Meningitis, cerebral and spinal,—it is said to have been efficiently used.

VERATRUM,—Hellebore.

Forms of Veratrum. *Veratrum viride*, American Hellebore or Poke-root, (nat. ord. Melanthaceæ,);—*Veratrum album*, European Hellebore; and *Veratrum sabadilla*, or *Asagræa officinalis*, the Mexican variety. Of these the first alone is official in the U. S. Phar., though an alkaloid or mixture of alkaloids from the Veratrum sabadilla is recognized under the name *Veratrine*. The alkaloids found in each plant are—

In V. viride,—*Jervine*, *Pseudo-jervine*, *Cevadine*, *Rubijervine*.
In V. album,—*Jervine*, *Veratralbine*, *Pseudo-jervine*, *Rubijervine*.
In V. sabadilla,—*Veratrine*, *Cevadine*, *Cevadilline*.

Veratroidine is now considered a mixture of Rubijervine and Resin.

Preparations.

Tinctura Veratri Viridis, ♏ij–x;—a 50 per cent. tincture of the root.

Extractum Veratri Viridis Fluidum, ♏j–v;—also from the root.

Veratrina, Veratrine, gr. $\frac{1}{60}$–$\frac{1}{10}$. Prepared from the seeds of V. sabadilla.

Oleatum Veratrinæ, Oleate of Veratrine,—strength, 1 in 50.

Unguentum Veratrinæ, Ointment of Veratrine,—strength, 1 in 25.

**Norwood's Tincture of Veratrum Viride*, has a very high reputation for efficiency,—Dose, ♏v, increased by ♏j every 3 hours, until pulse is down to 65, when the original dose will hold it there.

Physiological Actions. The action of *Veratrum Viride* is closely allied to that of Aconite, being a powerful cardiac depressant and spinal paralyzant. It differs from Aconite in affecting the respiration to a much less degree,—in being a systemic emeto-cathartic—in paralyzing the motor system centrally, impairing the reflexes, but leaving sensation unimpaired,—and in having little or no diaphoretic or diuretic action. It causes great depression, but is seldom fatal; when death does result from its use it usually occurs by paralysis of the heart.

In small doses Veratrum reduces the force of the pulse, but does not at first affect its rate. If continued for some time, the pulse becomes very slow, soft and compressible; rising, on the least exertion, to be very rapid and feeble. At the same time there is great muscular weakness, and frequently nausea and vomiting. Large doses increase these symptoms very much, the pulse becoming very rapid and so small as to be almost imperceptible; the skin is cold and clammy, and constant vomiting, extreme debility, giddiness, impaired vision, and partial unconsciousness ensue.

Jervine represents in part the depressant action on the circulation and on the central nervous system. It does not, however, affect the vagus, and but very slightly the voluntary muscles or the motor nerves. It irritates the motor centres in the brain, causing convulsions; and lowers the functions of the cord, of the centres in the medulla, especially the vaso-motor, and those of the cardiac ganglia,—slowing the heart by direct depression either of the cardiac muscle or its motor apparatus. It always causes salivation, but never vomiting or purging; and kills by asphyxia, the heart beating after respiration has ceased.

Veratroidine, on the contrary, always causes emeto-catharsis, and produces less violent convulsions. It stimulates the vagus centre and paralyzes the vagus ends, depresses the cord, and paralyzes the respiratory centre,—but at the same time increases the excitability of the vaso-motor centre. The result is great slowing of the pulse-rate and of respiration, and lowering of blood-pressure, until the carbonized blood irritates the vaso-motor centre, when the blood-pressure rises greatly. It probably consists of Rubijervine and a toxic resin.

Veratrum Album contains a very powerful alkaloid, *Veratralbine*, and also an irritant poisonous resin (?). Its general action is similar to that of its congener, but it is much more irritant to the gastro-intestinal mucous membrane, causing violent vomiting and purging, intense abdominal and œsophageal pain, greatly reduced temperature and pulse, collapse, and death from cardiac and respiratory paralysis.

Veratrine is an acrid, intensely irritant powder, probably consisting of a mixture of alkaloids. It causes violent sneezing, a burning sensation, and free salivation. It affects the heart and circulation similarly to the other Veratriæ and in addition seems to be a direct poison to muscular tissue, and to cause violent convulsions before the muscular paralysis sets in. The alkaloids *Jervine* and *Rubijervine* both depress the circulation, while the latter produces the emeto-catharsis.

Treatment in Veratrum Poisoning,—is similar to that for Aconite. *Morphine* and *Atropine* antagonize the cardiac depression,—also Alcohol, Ammonia, etc. The recumbent position should be maintained, and dry heat applied to the general surface.

Therapeutics. Veratrum Viride is inferior to Aconite in fevers and inflammations, by reason of its lack of power over excretion, but is used as an arterial sedative with excellent results in—

Aneurism,—to depress the circulation to the lowest point; the recumbent posture must be strictly observed, to secure safety to the heart.

Cardiac Disorders, such as simple hypertrophy, irritable heart,—Veratrum Viride is often used with great benefit.

Acute Mania and Puerperal Convulsions, it has frequently been employed with remarkably good results, but has often failed.

Parenchymatous and Serous Inflammations, in their early stages,—Veratrum Viride renders good service, especially in *Pneumonia.*

Superficial Neuralgiæ,—the Oleate or Unguentum Veratrinæ externally.

Myalgia and Headaches may often be relieved by the same application.

Puerperal Fever,—when due to metritis Veratrum Viride is highly extolled by Fordyce Barker and other authorities of standing.

Cholera, during the algid stage, Veratrum Album has been used, but other agents are far more efficient.

ARNICA AND TRIMETHYLAMINE.

Source and Composition. Arnica is the flower-heads and rhizome of *A. montana,* the Leopard's Bane, a perennial of the Composite order growing in mountainous districts throughout the northern hemisphere. It contains a principle, *Arnicin,* which is insoluble in water, and has some of the properties of a glucoside; also about 1 per cent. of an *Essential Oil,* with Inulin, Tannin, mucilage, resins, Capronic and Caprylic Acids. It also contains the ammonia compound *Trimethylamine*, which is supposed to be the active principle, and to be yielded by the essential oil.

Trimethylamine, is an ammonia compound of the group styled *amines*, in which the three atoms of hydrogen are replaced by some organic radical, in this case by Methyl, (CH_3), dissolved in water. It is a clear, colorless fluid, containing 10 to 20 per cent. of the absolute ammonia compound, has a disagreeable, fishy odor and taste, is strongly alkaline, and is miscible in all proportions with water. It is found also in Cod-liver Oil, in Humulus and Ergot, and may be obtained from codeine, fish-brine, human urine, herring-pickle, beet-sugar residue, and other decomposing albuminous substances. It behaves like an alkaloid, has strongly basic qualities, and has the formula $(CH_3)_3N$, or C_3H_9N. An impure, commercial trimethylamine is often called *Propylamine* erroneously, the latter being the name of an isomeric and allied compound.

Preparations. Both Arnica-flowers and root are official.

Tinctura Arnicæ Florum, Tincture of Arnica-flowers,—strength, 20 per cent. Dose, ♏v–ʒj. For local use, ℥ss to the pint.

Tinctura Arnicæ Radicis, Tincture of Arnica-root,—strength, 10 per cent. Dose, ♏v–xxx. Is locally irritant, unless greatly diluted.

Extr. Arnicæ Radicis Fluidum, Fluid Extr. of Arnica-root,—Dose, ♏v–xv.

Extractum Arnicæ Radicis, Extract of Arnica-root,—Dose, gr. j–v.

Emplastrum Arnicæ, Arnica Plaster,—has ⅓rd of the Extract.

**Infusum Arnicæ Florum*, Infusion of Arnica-flowers,—20 parts of the flowers to 100 of water, is thought by some to be the best preparation for local use, as it never excites dermatitis, probably by reason of its being devoid of the Essential Oil and the insoluble principle *Arnicin*.

**Trimethylaminæ Chloridum*, Chloride of Trimethylamine,—Dose, gr. j–v. Is powerfully antipyretic in doses of gr. ij every three hours.

Physiological Actions of Arnica. It is irritant, stimulant, depressant, antipyretic, diuretic, and a vulnerary. It irritates the gastro-intestinal tract, and in alcoholic solution excites erysipelatous inflammation of the skin in some persons. *In Small Doses* Arnica increases the action of the heart, raises the arterial tension, and stimulates the action of the skin and kidneys. *Large Doses* produce a transient excitement, followed by depressed circulation, respiration and temperature; violent headache, dilated pupils, and muscular paresis. *A Toxic Dose* paralyzes the nervous system of animal and organic life, causing collapse and death.

Trimethylamine—is an active escharotic, and a gastro-intestinal irritant; lowers the rate and force of the heart, decreases the body temperature, and diminishes (sometimes increases) the excretion of urea.

Therapeutics. Arnica may be used with benefit in—

Typhus and Typhoid Fevers,—5-minim doses of the Tincture as a stimulant; larger doses as an antipyretic when patient is of sthenic reaction.

Delirium Tremens with depression,—the Tincture is serviceable.

Rheumatism and Rheumatic Gout,—Arnica or Trimethylamine in the acute forms, to moderate the fever, subdue the joint inflammation, and lessen the danger of cardiac implication.

Sprains, Bruises, etc.,—the dilute Tincture locally has a popular reputation. *Ecchymoses* are rapidly dispersed by its use locally and internally. An infusion is better for local use, as the tincture may excite dermatitis.

Internal Bruises from shocks or concussions,—its internal use has proven very efficacious in many instances (Phillips).

Cuts, Wounds, etc.,—the aqueous preparations locally used promote the rapid union of cut surfaces.

Hemorrhages, Epistaxis, Hæmoptysis, etc.,—it is undoubtedly effective.

Concussion of the Brain,—Arnica is highly recommended (Phillips).

Chronic Dysentery, with slimy and bloody stools, tormina and cutting pains,—the Tincture internally is often a very efficient remedy.

Paralysis of the Bladder has been cured by Arnica, used internally.

Chorea,—Trimethylamine has been successfully used.

Chronic Rheumatism,—Trimethylamine as a liniment, 1 part to 3 of glycerin, gives relief to the pains, equal to that produced by any anodyne.

TABACUM,—Tobacco.

Source and Composition. The commercial dried leaves of *Nicotiana Tabacum*, (nat. ord. Solanaceæ), a native of tropical America. It contains a powerful liquid alkaloid *Nicotine*,—together with Malic Acid, alkaline salts, and a peculiar camphor named *Nicotianin*. Its combustion gives rise to several empyreumatic products, of which *Pyridine* is the most powerful. Tobacco-smoke contains little or no Nicotine; in that from pipes Pyridine preponderates, in that from cigars *Collidin*, which is much less active.

Liquid Alkaloids besides Nicotine,—Lupuline, Coniine, Lobeline, Piperidine, Pyridine, Muscarine, Sparteine, and the alkaloidal compound Trimethylamine.

Preparations. Tabácum (as above) is the only official preparation.

**Infusum Tabáci* (ʒj to the pint),—Dose, ℥ss–iij, as enema. Dangerous.

**Vinum Tabáci*, (℥j to the pint),—Dose, ♏v–ʒj. Must be used cautiously.

**Oleum Tabaci*, an empyreumatic product, obtained by distillation.

**Nicotina*, Nicotine,—Dose, ♏$\frac{1}{20}$–$\frac{1}{10}$, up to ♏ij in strychnine-poisoning.

**Pyridina*, Pyridine, C_5H_5N,—a colorless liquid of powerful odor, evaporating when exposed to air, mixing with water in all proportions, and forming salts like Chinoline. Dose, ʒj–ʒjss, allowed to evaporate in an open dish in a small room, in which the patient is exposed for 20 to 30 minutes thrice daily. (Seé).

Physiological Actions. Tobacco is a very depressant nauseant, an emetic by systemic and irritant action, a sternutatory, diuretic, diaphoretic, cathartic, sedative, antispasmodic, and narcotic. It first stimulates and afterwards paralyzes the motor nerves of involuntary muscles, and the secreting nerves of glands, also the spinal cord and the vagus; at first stimulating both the vagus-roots and its ends in the heart (slowing the pulse-rate), but afterwards paralyzing the latter (causing high pulse-rate). It produces increased salivary and intestinal secretions, diuresis, tremor, clonic spasms, and a tetanic stage previous to its paresis. It contracts the pupils, slows and depresses the heart, first lowers and then raises the arterial tension, and reduces the body temperature; causes profuse sweating, cold and clammy skin, collapse, and death usually by paralysis of respiration, sometimes by paralysis of the heart. It does not impair the muscular irritability, nor does it act on the cerebrum directly.

The empyreumatic products of Tobacco are similar in action but less powerful. Fatal results have followed the inhalation of the vapor.

The continued use of Tobacco by smoking or chewing to excess produces granular inflammation of the fauces and pharynx, atrophy of the retina, dyspepsia, lowered sexual power, sudden faints, nervous depression, cardiac irritability and occasionally angina pectoris. Used by the young it hinders the development of the higher nervous centres, and impairs the nutrition of the body by interfering with the processes of digestion and assimilation.

Nicotine is almost as rapidly fatal as Prussic Acid, death having occurred from a toxic dose in three minutes, with no symptoms except a wild stare and a deep sigh.

Antagonists and Antidotes. *Strychnine* is the true physiological antagonist of Nicotine (or Tobacco) and vice versa. Alcohol, Ammonia, Ergot, Digitalis, Belladonna, etc., antagonize its action on the circulation. Evacuation of the stomach, Tannin, Iodides, and artificial respiration, are the means resorted to in Tobacco-poisoning.

Therapeutics. Tobacco is now but little used in medicine. The chief indications for it are (1) to relax spasm, (2) locally, to relieve pain. But the danger attending its employment, either internally or externally, has caused its supersedence by other agents of less violent action. It may be employed in—

Habitual Constipation,—the wine is a good remedy, ♏v at bedtime. Smokers rarely suffer from constipation, but frequently experience an immediate laxative result after their morning cigar.

Intestinal Affections, as impaction of the cæcum, intussusception, and strangulated hernia,—not over ℥iv of the Infusion as an enema has often been very effective in relaxing spasm, but it is a dangerous expedient.

Asthma,—emphysematous, cardiac and nervous forms, are all benefited by the use of Pyridine (as described above); which has a powerfully sedative action upon the respiratory centre.

Tetanus,—no remedy more effective than minim-doses of the alkaloid every two hours by the stomach, or ♏ij by the rectum; or ℥iv of the Infusion as an enema, repeated for effect; or still better, the Wine, in ten-minim doses, repeated for effect. [See formula below.]

Dropsy, especially in the renal form,—Tobacco is an efficient diuretic.

Nymphomania, *Chordee*, *etc.*, are easily conquered by Tobacco.

Strychnine Poisoning,—Tobacco is an effective antagonist. Gr. ss of Nicotine in ʒij Aquæ destil. hypodermically; of this ♏x contain gr. $\frac{1}{24}$. The Infusion has also been used successfully, but the alkaloid permits of more precise administration.

Fatigue,—Tobacco, moderately used, aids to support the system, when under excessive exertion, food and rest being deficient.

LOBELIA,—Indian Tobacco.

Source and Composition. The leaves and tops of *Lobelia inflata*, (nat. ord. Lobeliaceæ), a North American weed. It contains a liquid alkaloid, *Lobeline*,—also *Lobelic Acid*, *Lobelacrin*, resin, wax, etc.

Preparations.

Tinctura Lobeliæ, 20 per cent. ♏v–xxx. *Acetum Lobeliæ*, 10 per cent. ♏v–ʒj.
Extractum Lobeliæ Fluidum, ♏j–x. **Lobelin* (a resinoid), gr. ss–gr. j.

Physiological Actions. Lobelia has an acrid, nauseous taste, and a very unpleasant odor. It is expectorant, diaphoretic, purgative, emetic, anti-spasmodic and narcotic. It excites an abundant flow of saliva, much gastric mucus, and profuse urination and sweating; with nausea, vomiting, and great depression. The action of the heart is enfeebled, the blood pressure, at first increased, soon falls; muscular debility, reduced temperature ensue, then coma and death by paralysis of the respiratory centre. The motor nervous system is chiefly affected, especially the medulla oblongata, and the nucleus of the pneumogastric contained therein.

Physiological Antagonists. Strychnine, Picrotoxin, Thebaine, antagonize its action on the nervous system; the vaso-motor excitants, as Alcohol, Digitalis, Belladonna, oppose its effects on the circulation.

Therapeutics. Lobelia has gone out of fashion, yet is useful in—

Asthma,—a teaspoonful of the Tincture every 15 minutes until nausea ensues, gives decided relief in the paroxysm.

Cough of dry, harsh character, with tickling in the throat and spasmodic dyspnœa,—Lobelia is an extremely effective expectorant.

Constipation, from atony and deficient secretion,—a ten-minim dose of the Tincture or Acetum at bedtime is excellent.

Impaction of the Cæcum, before inflammation occurs,—two-drop doses of the Tincture every hour will often relieve the obstruction.

Strangulated Hernia,—the Infusion as an enema is much safer than Tobacco, and fully as efficient; but other laxatives are better.

Intussusception,—the Infusion as an enema may overcome the obstruction, but it is rarely used.

Poison-oak Eczema,—an Infusion (℥j to the pint) locally, is efficient.

As an Emetic Lobelia is entirely too depressant to be given to children.

THE NITRITES.

Amyl Nitris, Nitrite of Amyl, ($C_5H_{11}NO_2$),—is a clear, yellowish, oily liquid, of a powerful and ethereal odor, extremely volatile, insoluble in water, but soluble in alcohol, ether, chloroform and benzin. It is produced by the action of Nitric or Nitrous Acid upon Amylic Alcohol, and may be administered by inhalation or internally, in doses of ♏ij–v, but larger doses are probably safe.

* **Nitro-Glycerinum, Trinitrin, or Glonoinum**,—Nitro-Glycerin, Trinitrin, Glonoin, Nitrate of Glyceryl, $C_3H_5(NO_3)_3$, a clear, oily liquid, insoluble in water, but soluble in alcohol. It is produced by the action of Nitric and Sulphuric Acids upon Glycerin, and may be administered in doses of ♏$\frac{1}{100}$. It is highly dangerous as an explosive, and should not be kept in stronger solution than a 1 per cent. solution in alcohol.

* *Tabellæ Nitroglycerini*, (B. P.),—each contains gr. $\frac{1}{100}$.

* *Trinitrin Tabloids*,—gr. $\frac{1}{20}$, $\frac{1}{25}$, $\frac{1}{33}$, $\frac{1}{50}$, $\frac{1}{100}$, $\frac{1}{200}$, each,—are made by several manufacturers, and are in the shops.

* *Tinctura Trinitrini*, Tincture of Nitroglycerin,—strength 1 per cent. Dose, ♏ss–♏x. The strong tincture official in the American Homœopathic Phar-

macopœia, (2d ed. Boericke & Tafel, Philadelphia, 1883, page 235), and presumably sold by them on demand, is a ten per cent. solution, or ten times stronger than the above. It is an extremely dangerous preparation, both as an explosive and as a medicine.

* **Sodii Nitris,** Nitrite of Sodium, gr. ss–gr. ij or v, according to individual susceptibility.

* **Potassii Nitris,** Nitrite of Potassium,—Dose, gr. ss–v.

Physiological Actions. The Nitrites agree in their general action, producing great vascular dilatation and consequent lowering of blood-pressure, by paralyzing either the sympathetic system, the vaso-motor centre, or the muscular coat of the arterioles;—tumultuous action of the heart, by relaxation of its inhibitory apparatus;—diminished sensation, motion and reflexes; a sensation of heat, but lowered body temperature; lowered respiration, from paralysis of the respiratory muscles and impairment of the ozonizing function of the blood; throbbing pain in the head, beating carotids, flushed face and vertigo. They are all muscle poisons.

Amyl Nitrite is the most prompt, but less enduring in action, and is best given by inhalation. *Nitrite of Sodium* acts similarly, but less promptly. *Nitro-glycerin* is less prompt and less violent, has a more enduring action, and is therefore more suitable for internal administration. Its headache is of intense frontal character, and persists for hours after the other effects have passed off.

Therapeutics. The Nitrites are well used in—

Angina Pectoris, especially when characterized by a great rise of arterial tension,—Amyl Nitrite inhaled, to lessen the arterial spasm and palliate the agony of the attack, is usually very efficient.

Epilepsy,—when the aura is felt, the inhalation of a drop or two of Amyl Nitrite will generally abort the paroxysm. Its repetition requires increased dosage to produce the desired effect.

Respiratory Neuroses, as spasmodic asthma, whooping-cough, laryngismus stridulus, etc., are relieved in many cases by these agents.

Tetanus is palliated by Amyl Nitrite, especially during the period of fixation of the muscles of respiration.

Neuralgic Dysmenorrhœa has often been benefited by Trinitrin.

Vomiting and *Nausea,* also *Sea-sickness,* are benefited by the Nitrites.

Cold Stage of Intermittents and pernicious remittents,—may be aborted by the inhalation of Nitrite of Amyl, preventing internal congestions.

Syncope, and in *Chloroform Poisoning,*—Amyl Nitrite to aid the circulation, conjoined with artificial respiration, etc.

Myxœdema,—Trinitrin in conjunction with Elaterium, is said to have proved useful.

High Arterial Tension, and Blood-pressure, from any cause,—these agents are exceedingly useful, especially Trinitrin.

Chronic Interstitial Nephritis,—Trinitrin has proved of great value, by redistributing the blood supply to the kidneys, cut off by degeneration of the renal ganglionic centres.

Migraine, of the pale-face form,—Amyl Nitrite is indicated, or Trinitrin.

Convulsions, of various kinds, including puerperal,—the Nitrites are useful.

ACIDUM HYDROCYANICUM,—Prussic Acid.

Preparations.

Acidum Hydrocyanicum Dilutum, ♏j–iij. Is a solution of 2 per cent. of the anhydrous acid in 98 per cent. of alcohol and water. ♏xl of this preparation have proved fatal. It is a constituent of the secret nostrum *Chlorodyne*, also of its various imitations, including the B. P. preparation *Tinctura Chloroformi et Morphinæ*, recently introduced therein.

**Scheele's Dilute Hydrocyanic Acid* is a 4 or 5 per cent. solution, and is highly dangerous, even by inhalation.

Potassii Cyanidum, gr. $\frac{1}{20}$–$\frac{1}{10}$. Locally, a solution of gr. j–v to the ℥.

Oleum Amygdalæ Amaræ, Oil of Bitter Almond,—contains a varying quantity of Hydrocyanic Acid, due to the reaction between the principle Amygdalin and the ferment Emulsin. Dose, ♏¼–j, in mixture.

Physiological Actions. Hydrocyanic Acid and Nicotine are the most powerful poisons known, gr. ss of the former having caused death. Its inhalation produces rapid insensibility and almost immediate exhaustion, death probably occurring from sudden paralysis of the heart in the more rapid cases and of the respiration in the slower ones. Some volitional movements may be made before death, unless the dose be very large. Its paralyzant action is expended on the brain centres, the peripheral afferent nerves, then on the spinal cord, the motor nerves and the muscular tissue, the muscles being fixed in tetanic rigidity after death. The blood is found, on post-mortem examination, to be dark and fluid, and the venous trunks and cerebral sinuses gorged therewith. The odor of Prussic Acid is fragrant, resembling that of bitter almonds or peaches. The effects of a medicinal dose pass off in an hour, at most.

Cyanide of Potassium has similar action, and, in addition, possesses some peculiar to itself. Locally, it causes inflammation of the skin, with an eczematous eruption, and if applied in quantity to an abraded surface will produce fatal effects.

Physiological Antagonists. *Atropine* has antagonistic action, but is too slowly diffused to be of any value. *Ammonia* by inhalation, by the stomach, and by intravenous injection, with cold affusion to the spine and artificial respiration,—are the measures most likely to avail in cases of poisoning, where there is time to do anything.

Antidote to Cyanide of Potassium,—is *Sulphate of Iron*, producing Prussian Blue (Ferrocyanide of Iron). Then evacuation of the stomach, artificial respiration, and *Ammonia* by intravenous injection.

Therapeutics. Hydrocyanic Acid is a very useful and pleasant remedy. It is well employed in—

Coughs of spasmodic character, whooping-cough, hiccough, laryngismus stridulus, and other neuroses of the respiratory organs, or affections involving the pneumogastric nerve.

Gastralgia,—it is one of the most efficient remedies, also in *Headache and Vertigo* due to stomachal derangement; and in *Nervous Vomiting* of various kinds,—it is efficient.

Acute Mania and Melancholia,—it has been successfully employed.

Round Worms (*Lumbricoides*), are promptly killed by doses of 2 or 3 minims every 2 hours for 24 hours, followed by calomel. Both agents, being tasteless, are useful for children.

Skin Diseases, *Pruritus*, etc.—Hydrocyanic Acid is a very grateful application to allay itching. Or the Cyanide of Potassium in ointment, gr. v or vj to the ℥, carefully avoiding abraded surfaces.

Headache, of reflex type,—Cyanide of Potassium in solution, gr. iij–v to the ℥, applied locally on a compress, gives great relief.

Stains from Nitrate of Silver are removed by a similar solution.

*BARIUM,—Barium.

Preparations. But one is used, viz.—

*_Barii Chloridum,_—Dose. gr. ss–v, is freely soluble in water or alcohol.

Physiological Actions. Barium has a strongly metallic taste, excites secretion and salivation, and is a gastro-intestinal irritant, causing nausea, vomiting and purging. *In Small Doses* it stimulates the organic nerves, producing prompt peristalsis of the intestines, and contraction of the muscular layer of the arterioles. *On the Heart* its action is at first slightly depressant, soon followed by a rapid rise. The arterial tension is greatly raised by constriction of the arterioles almost to obliteration of their capacity, and the heart is at the same time slowed. *A Toxic Dose* dilates the pupils, causes muscular tremor and rigidity, convulsions and insensibility. It paralyzes the nervous system, death occurring by paralysis of respiration.

Treatment of Barium Poisoning. The sulphate being very insoluble, it should be produced and then evacuated. *Amyl Nitrite*, *Nitro-glycerin* and similarly acting agents are its physiological antagonists.

Therapeutics. Barium was originally employed as an "alterative," but had fallen into disuse. It is a useful drug in—

Aneurism and Hemorrhage, in which its contractile power over the vessels may be advantageously employed.

Congestions of various kinds,—should be a good field for it;—and it is indicated in *Paralysis of the Bladder*, and in *Constipation* due to lack of secretion or to torpor of the intestinal muscular fibres.

GRINDELIA,—Grindelia.

Source and Composition. The leaves and tops of *Grindelia robusta*, an herbaceous Californian plant, (nat. ord. Compositæ.) Its composition has not yet been definitely ascertained; but it probably contains an alkaloid, a resin, and a volatile oil.

Preparations. Only one is official,—

Extractum Grindeliæ Fluidum, ♏v–ʒj. Is extremely nauseous.

**Tinctura Grindeliæ*, ♏x–ʒij. **Extractum Grindeliæ*, gr. ij–v, in pill.

Physiological Actions. Grindelia is not actively toxic, large doses being required to kill small animals. Taken in quantity it excites nausea and vomiting, depresses the heart, respiration and temperature, dilates the pupils, and causes sleep with lowered cutaneous sensibility and reduced reflexes. Finally it produces motor paralysis, beginning in the legs, and causes death by paralysis of the muscles of respiration. It is slowly eliminated by the kidneys and the lungs, imparting to the urine and breath a peculiar violaceous odor. It is markedly diuretic.

Therapeutics. Grindelia is especially indicated in spasmodic affections of the respiratory organs. In—

Spasmodic Asthma,—as a palliative; 3-grain doses of the extract to avert the attack, or ♏xx–xxx of the fluid extract every half hour, beginning at the very onset. The dried leaves may be smoked in cigarettes, or the plant may be steeped in a saturated solution of potassium nitrate, dried and ignited, the patient inhaling the fumes.

Hay Fever,—is amenable to Grindelia in many instances; the fluid extract 4 parts, with 1 part each of the fluid extracts of Rhubarb and Senna, of which ʒij every half hour during the paroxysm, and afterwards at intervals of three hours.

Chronic Bronchitis and Emphysema,—it is of real utility; also in acute bronchitis after the subsidence of the acute symptoms.

Whooping-Cough, Coughs of Imitation and Habit, and those of spasmodic character,—are helped by Grindelia.

Spasmodic Dyspnœa, accompanying various pulmonary and cardiac diseases,—Grindelia is often a very efficient remedy.

Chronic Pyelitis and Cystitis, and other catarrhs of the genito-urinary passage,—Grindelia is very serviceable, being deposited as an oleo-resin all along the urinary tract.

Rhus Poisoning,—the fluid extract of Grindelia is said to be one of the most efficient local applications in poisoning by Rhus toxicodendron, and is also used internally as an antidote thereto.

* QUEBRACHO,—Quebracho.

Source and Composition. The bark of Aspidosperma Quebracho (Q. Blanco), an evergreen tree growing in Chili and the Argentine Republic. It is supposed to contain six alkaloids, the most important of which are named *Aspidospermine, Quebrachine,* and Aspidosamine.

Preparations. * *Vinum Quebracho,* ʒj–℥j.
* *Tinctura Quebracho,* ʒj–ij. **Extractum Quebracho Fluidum,* ♏v–ʒj.

Physiological Actions. Quebracho has a bitter taste, and in large doses causes severe salivation, nausea, vomiting, vertigo and headache. It lessens the rate of respiration, and seems to decrease the sensation of need for air after active exercise.

Of the three important alkaloids Quebrachine is the most active, but all of them act similarly upon the lower animals,—affecting the central nervous system, at first by stimulation, which is soon followed by paralysis. The heart and respiration are chiefly affected; at first the fulness and rate of breathing is increased, and the cardiac action slowed; but finally both functions are paralyzed, the cardiac first in warm-blooded animals, the respiration first in cold-blooded ones. Reflex excitability, at first increased, is soon lowered, and the spinal cord is also paralyzed. Locally used these alkaloids paralyze voluntary muscular fibre also, and some of them similarly affect the motor nerve endings.

Therapeutics. Quebracho is extensively advertised for—

Dyspnœa, from any cause, in which it is said to be palliative, but as often fails. It may relieve the dyspnœa of asthma, emphysema, bronchitis, etc., but is useless in that due to organic disease of the heart, or in aged subjects of atheroma.

PHYTOLACCA,—Poke.

Source and Composition. The berry and root of *Phytolacca decandra*, (nat. ord. Phytolaccaceæ), a N. American plant. It contains a neutral principle, *Phytolaccin;* also *Phytolaccic Acid*, tannin, starch, a fixed oil, etc.

Preparations. Though both the berry and root are official, no preparations are mentioned in the U. S. Pharmacopœia.
Phytolaccæ Bacca, Poke-berry. *Phytolaccæ Radix*, Poke-root, gr. j–ʒss.
**Tinctura Phytolaccæ*, ♏x–ʒj. **Extr. Phytolaccæ Fluidum*, ♏v–ʒss.

Physiological Actions. Phytolacca depresses the heart-rate and the respiration, and is a paralyzer of motion by central action on the spinal cord. It is a slow and depressant emeto-cathartic, also somewhat narcotic and alterative. It irritates the throat and tonsils; produces tetanic convulsions in animals, and death by paralysis of respiration. Several cases of poisoning by this plant have occurred.

Therapeutics. Phytolacca is useful in—
Mastitis, to arrest the inflammation and prevent suppuration,—the extract may be applied locally and the fluid extract given internally.
Varicose Ulcers, and other ulcers of the leg,—it promotes healing.
Eczema of obstinate character,—has been cured by Phytolacca extract applied locally; also *Tinea Capitis*, and other skin affections.
Chronic Rheumatism of fibrous tissues,—used internally, it acts efficiently.
Tonsillitis, *Diphtheritic Sore Throat* and *Chronic Follicular Pharyngitis*,—are affections in which Phytolacca has been much employed with good results, especially when high fever and pains in head, back and limbs. In true adynamic Diphtheria it will do little good.

*AILANTHUS,—Tree of Heaven.

Source and Composition. The bark of *Ailanthus glandulosa*, (nat. ord. Simarubaceæ) a well-known shade-tree. Its properties probably depend on the Oleo-resin and Volatile Oil which it contains. Dose, in powder, gr. x–ʒj.

Preparations.
**Tinctura Ailanthûs*, ♏x–ʒij. *Extr. Ailanthûs Fluidum*, ♏x–ʒj.

Physiological Actions. Ailanthus paralyzes the cerebrum and spinal cord of animals, the loss of motility beginning in their hind extremities. It is a drastic purgative and a decided nauseant, causing also weakness, vertigo, cold sweats, dull headache, pains in the back, numbness and tingling in the limbs. The heart's action is at first increased, but soon becomes slowed, the respiration being also depressed, death occurring by paralysis of respiration. Ailanthus is a good tæniafuge.

Therapeutics. It has well been employed in—

Malignant Scarlatina, with dark and partial eruption, insensibility, delirium, and other symptoms of cerebral implication.

Tape-worm,—a decoction of the fresh bark (ʒj ad ℥iv) is very efficient, or the oleo-resin in drachm-doses.

ANTIZYMOTICS, ANTIPYRETICS, ANTIPERIODICS.

Antizymotic Drugs are those which arrest the fermentative processes, (see *ante*, page 43), including the Antiseptics, the Disinfectants and the Deodorants, etc. Many of these agents are also endowed with other qualities of great therapeutical value, due indirectly to their power over ferments; such ones being Antipyretics and Antiperiodics, as well as Antiseptics. [See also pp. 36 and 37, *ante*.] The members which stand at the head of this triple-crowned group, are the four

CINCHONA ALKALOIDS.

Quinine, Quinidine, Cinchonine and **Cinchonidine**; and of these the chief, the king of antizymotic, antipyretic, antiperiodic agents, is **Quinine**, which has already been described on page 63. The composition of Quinine is represented by the formula $C_{20}H_{24}N_2O_2$; it is soluble in about 1600 parts of water and in 6 of alcohol at 59° F.; but it is rarely employed in its uncombined form, its various salts being much more soluble. The salt generally employed is the Sulphate, (see *ante*, page 63), but the Bisulphate, Hydrobromate and others, are frequently used. The Carbamide Hydrochlorate of Quinine is the most soluble and the least irritating of the salts, and therefore the best one for hypodermic administration.

Substitutes for Quinine.

The synthetical production of Quinine has been the "philosopher's stone" of the modern chemists, who have prosecuted with untiring energy the search for an artificial product possessing all its properties. Though in this they have as yet been unsuccessful, they have discovered several organic bodies, which closely resemble each other and also quinine, both in chemical constitution and physiological action. These substances belong to the aromatic series of carbon compounds, all of which are derivatives of *Benzene* or *Benzol*, C_6H_6, the Hydride of the organic radical *Phenyl*, C_6H_5. The distinctive action of the lower members of this series is their *antiseptic* and *antipyretic* powers,—as that of the fatty series of carbon compounds is *stimulant* and *anæsthetic* (Brunton). Many of these agents are obtained from coal-tar oil (petroleum) by fractional distillation, etc.,—and they are all derivatives of Benzene (Benzol), either directly or from some of the products formed therefrom, by substitution; various radicals replacing the different constituent atoms of H and C.

Thus, by the ring-arrangement of atoms peculiar to this series, there are formed from Benzene (C_6H_6), the following substances, viz.—

Phenol, or *Carbolic Acid*, C_6H_5OH—by replacing H by OH, (hydroxyl).
Pyrocatechin,† or *Ortho-* $C_6H_4(OH)_2$.
Resorcin,† or *Meta-* *di-hydroxy-benzene*,—by replacing 2H by 2OH.
Hydroquinone,† or *Para-* $C_6H_4(OH)_2$.
Pyrogallol, *Pyrogallic Acid*, *Tri-hydroxybenzene*, $C_6H_3(OH)_3$,—3H by 3OH.
Amido-benzene, or *Anilin*, $C_6H_5.NH_2$—by replacing H by NH_2 (amidogen).
Nitro-benzene, $C_6H_5.NO_2$—by replacing H by NO_2 (nitroxyl).
Benzoic Acid, $C_6H_5CO.OH$—by replacing H by CO.OH (carboxyl).
Salicylic Acid, $HC_7H_5O_3$—by replacing 2H by OH and CO.OH.
Naphthaline, $C_{10}H_8$—by uniting 2 Benzines in an over-lapping ring.
Pyridine, C_5H_5N—by replacing tetrad C by triad N.
Chinoline, C_9H_7N—uniting Benzene (C_6H_6) and Pyridine (C_5H_5N).
Derived from Chinoline is the hypothetical base—
Chinicine or *Quinicine*, $C_9H_9N_2$,—represented in Antipyrine.
Also *Kairine*, *Thallin*, and other compounds.

* CHINOLINA,—Chinoline.

Source and Composition. Chinoline, C_9H_7N, also called Leucoline, is a constituent of coal-tar oil —but may be obtained from Quinine or Cinchonine by their destructive distillation with potassium· hydrate,—and may be artificially prepared by heating Anilin or Nitro-benzol with glycerin in the presence of a dehydrating agent. Chemically, it is considered to be formed by a union of Benzene and Pyridine atoms.

Characteristics. It is a colorless, oily liquid, strongly refractive, boiling at 460° F. without decomposition, turns dark on exposure to the air; soluble in alcohol, ether and carbon disulphide, sparingly so in water. It combines, like an alkaloid, with acids to form crystalline salts; all of which, except the tartrate, are very deliquescent.

Preparations. Only one salt is employed, viz.:—
* *Chinolinæ Tartras*, Tartrate of Chinoline. Dose, gr. v–xx.

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† These three are isomeric, differing only in the relative position of the hydroxyl atoms in the benzene ring,—*i. e.* 1 and 2, 1 and 3, 1 and 4, denoted respectively by the prefixes Ortho- Meta- and Para-.

Physiological Action and Therapeutics. Chinoline is a powerful antiseptic and antipyretic, closely resembling Quinine in its action, but of very disagreeable taste and odor. In moderate doses it lowers the pulse-rate and reduces the body-temperature; in large ones it diminishes reflex excitability, and causes dyspnœa, paralysis and collapse.

The members of the chinoline series of compounds destroy life either by exhaustive convulsions or gradual paralysis of the respiratory centre,—the lower ones acting chiefly on the sensory centres of the brain and reflex centres of the cord, destroying voluntary and reflex movement; while the higher ones act principally on the motor centres, first as irritants, causing violent convulsions, and afterwards producing paralysis (Brunton).

Chinoline has been used in typhoid fever, acute rheumatism and erysipelas, also in typhus, diphtheria, etc., with varying success. In the latter disease, a 5 per cent. solution in weak alcohol is painted over the affected surface with great benefit. The tartrate has been used with benefit in neuralgia and whooping-cough, and as an antiperiodic in intermittents.

*ANTIPYRINA,—Antipyrine.

Source and Composition. Antipyrine is an alkaloidal product of the destructive distillation of coal-tar oil, and may also be prepared synthetically. It has the formula $C_{20}H_{18}N_4O_2$—and the chemical name Di-methyl-oxy-chinicine;—being derived from the hypothetical base Chinicine, or Quinizine, which itself is a derivative of Chinoline. [See *ante*, p. 179.]

Characteristics. It occurs as a whitish, crystalline powder, which combines with acids to form salts, is somewhat bitter, and soluble in one-half its weight of hot water, and in its own weight of cold water; but is still more so if the water is acidulated with dilute nitro-hydrochloric acid. It is less soluble in alcohol, chloroform or ether, gives an intensely *red* color with Ferric Chloride, and a beautiful *green* with Nitric Acid. It is not irritant to either the stomach or the tissues, and may be administered hypodermically.

Dose and Administration. The full dose for an adult is put at gr. xxx hourly for three hours, or gr. xc for the antipyretic effect. For children, gr. j for each year of age as a dose, to be repeated twice, or for three successive hourly doses. If vomiting result, the same dose may be dissolved in half its weight of *hot* water, and injected hypodermically while warm.

Antipyrine has but little flavor, is not unpleasant, and is therefore readily taken by children, in which respect it is greatly superior to quinine. It may be administered in compressed tablets, each having 3, 5 or 10 grains;—or in Elixir Aurantii,—say gr. lxxx in ℥iv, of which each ʒ contains gr. ijss.

Physiological Action. Antipyrine is a powerful antipyretic, a local anæsthetic, and a general analgesic,—and also possesses diaphoretic, mydriatic, antiseptic, disinfectant, hemostatic and slightly hypnotic powers. After the ingestion of a full medicinal dose, (gr. xxx), there is a stimulant stage of short duration, in which the heart's action is increased, and a subjective sense of heat is experienced, with flushing of the face. This is soon followed by profuse sweating, coldness of the surface, slowed pulse, considerable depression, and if fever be present by *lowered temperature;* the latter coming on within half-an-hour after taking the drug and its degree being in direct ratio to the quantity administered, as also its continuance,—the former being usually from 3 to 5 degrees, and the latter from 1 to 10 hours, a fair average being about 2 hours. In one case a fall of 12° F. was observed.

When given with Kairine, the mixture of the two drugs has been found to produce a much greater fall of temperature, with longer continuance down, than that produced by an equal quantity of either drug given alone.

After the antipyretic effect of the dose has passed off, the temperature (in fever) commences to rise again,—the onset being usually preceded by a chill, which is of slight degree when compared with the severe rigors and dangerous depression occurring under the action of Kairine, Chinoline, and other members of the group.

In health its administration gives rise to slight nausea, singing in the ears, and a reduction of the body temperature of scarcely any extent, about $\frac{1}{10}$° F. It slightly raises the arterial tension and blood-pressure;—sometimes (but seldom) induces vomiting, also a peculiar eruption on the skin;—and (very rarely) such a degree of depression as to amount to collapse. It has no effect upon the respiration, but acts as a sedative upon the cerebrum, leaving behind a somewhat depressant influence on the brain. It dilates the pupils and is eliminated by the kidneys, appearing in the urine some 3 hours after its ingestion. The profuse sweating, which it causes, may be prevented by giving in advance a small dose of Atropine or Agaricine.

In toxic dose its principal influence is exerted upon the blood, altering the shape of the red corpuscles, separating the hematin, and causing decomposition of that fluid.

As an Antipyretic, Antipyrine, like Alcohol, acts by a double mode of operation,—(1), by diminishing oxidation, and (2) by promoting heat-loss. The latter is attained by dilating the cutaneous vessels, allowing free radiation from the surface, and by the refrigerant action of the evaporation of the sweat.

As an Analgesic, Antipyrine has a very considerable degree of power, in common with all the Chinoline derivatives; but its property in this respect is found to act almost entirely upon pain due to manifestations of the rheumatic diathesis. In general anodyne action, it is not to be compared with the derivatives of Opium. Its hemostatic power is claimed to be superior to that of Ergotine.

Therapeutics. By far the most popular of the modern antipyretics, Antipyrine deserves its rank in professional esteem, being the most certain, the most powerful and the least dangerous;—but devoid of any other influence upon the course of any febrile disorder. Its principal applications are as follows, viz.—

In Hyperpyrexia from any cause, it is efficient.

Acute Rheumatism, it has held the first place as a remedy, for some time; a claim which is now disputed in favor of Salol.

Typhoid Fever and other febrile conditions, wherein hyperpyrexia occurs, as phthisis, erysipelas, pleuritis, pneumonia, surgical fever, etc.

Neuralgiæ, *Neuritis*, and other painful affections, especially when of rheumatic origin,—as lumbago, sciatica, hemicrania, supra-orbital neuralgia, etc., in which 15-grain doses are generally sufficient, and may be given hypodermically.

Painful Affections of hysterical persons;—pain from cerebral tumors and from cardiac diseases,—also painful menstruation;—all of which are promptly relieved by it.

*ACETANILIDE,—Antifebrin.

Source and Composition. Like the major number of the newest antipyretics, which are related either to Chinoline or to Phenol, *Acetanilide* is a derivative of *Anilin*, (see page 179), from which it is obtained by the action thereon of glacial acetic acid, substituting the organic radical Acetyle for an atom of hydrogen. Chemically, it has the name *Acetanilide* or *Phenyl-acetamide*, and the formula $C_6H_5.C_2H_3O.NH$.

The name *Antifebrin* is copyrighted by its original promotors for trade purposes, and therefore should be dropped from professional usage.

Characteristics. A pure white and crystalline powder, of neutral reaction, odorless, but of slightly burning taste. It melts at 235° F., and distils at 557° F.,—is soluble freely in alcohol, wine, etc.,—but very sparingly (1 in 190) in cold water, and a little more readily in hot water. It is a neutral substance, being unaffected by hydrochloric or sulphuric acids, and ordinarily so by alkalies.

Dose and Administration. The dose ranges from gr. ij to gr. xv, repeated twice, but not exceeding gr. xxx in the 24 hours. As much as ʒj has been swallowed without ill effects supervening. It may be administered in the very convenient form of compressed tablets;—also in powders, or in dilute alcoholic solution. ʒj may be dissolved in ℥ivss of brandy, to which, if we add ʒvj each of simple syrup and water, we get a six-ounce mixture, of which a tablespoonful (℥ss) contains 5 grains of Acetanilide, a fair adult dose. As an antipyretic, gr.iij may be administered every ¼ to ½ hour, until 12 or 15 grains have been given, which will usually be a sufficient quantity, especially if given at the acme of the febrile movement.

Physiological Action. Acetanilide is a very efficient antipyretic, besides being strongly analgesic and antispasmodic, lessening the reflex action of the spinal cord, and inhibiting the sensibility of sensory nerves. It raises the arterial tension somewhat, and slows the heart in a corresponding degree.

Compared with the action of Antipyrine, the effect of Acetanilide on the body-temperature is manifested more slowly (1 hour against ½ hour),—but lasts a longer time (6 against 2 hours). It is markedly diuretic, somewhat diaphoretic; is a cerebral, muscular and vaso-motor stimulant, and leaves no ill after-effects;—while Antipyrine is powerfully diaphoretic, a cerebral sedative, and produces great depression. Furthermore, Acetanilide produces the same degree of reduction of body-temperature as Antipyrine, with the ingestion of but ¼th the dose; and, like the latter agent, it has little or no effect on the normal temperature, and its continued use begets tolerance of its action.

Its Antipyretic action corresponds, in degree and in duration, to the size of the dose,—the pulse is slowed, and quiet sleep often follows. There is neither vomiting nor diarrhœa afterwards, but there is a tendency, in some few cases, to collapse, with chills and cyanosis, especially the latter, during the period of depressed temperature.

A toxic dose destroys the ozonizing function of the blood, forming methyl-hæmoglobin. The heart, liver and kidneys are found in a state of acute fatty degeneration, in animals poisoned thereby.

Therapeutics. Besides being one of the most efficient antipyretics, this drug has marked analgesic and antispasmodic powers; and these, together with its great advantages of a small dose, efficiency and safety, and the absence of the severe rigors and cardiac depression which mark the chinoline derivatives,—combine to make it one of a wider therapeutical range than most of its analogues. It is especially useful in—

Phthisis and Typhoid Fever,—for the hyperpyrexia, and thereby relieving wakefulness, lessening delirium, and upholding a failing heart.

Pains of Locomotor Ataxia,—and in those of rheumatic origin, sciatica, lumbago, etc., it is a most efficient remedy.

Acute Rheumatism,—it is highly praised; though its efficiency is herein disputed by Salol.

Epilepsy,—it is being tried, with the view of moderating reflex excitability.

*KAIRINA,—Kairine.

Source and Composition. Kairine is the hydrochlorate of an artificial alkaloidal substance prepared from Chinoline,—having the chemical name *Hydrochlorate of Oxy-ethyl-chinoline Hydride*, and the formula $C_{10}H_{13}NO.HCl.H_2O$.

Characteristics and Dose. It occurs as a white, crystalline powder, freely soluble in water, but is best administered in wafer-paper or in capsule. Dose, gr. iij–gr. xxx. As antipyretic, gr. viij hourly for four doses, or until 100° F. is reached, then gr. iv, hourly during the period of defervescence.

Physiological Action and Therapeutics. Kairine is a powerful antipyretic, producing however profuse sweating and vomiting; and a severe rigor ushers in the subsequent rise of temperature, when its influence has worn off. In some cases of typhus it has caused cyanosis and collapse, but has not yet proven fatal, though 220 doses have been given in one case. It stains the urine a deep green color. By many authorities this drug is considered the most certain, most powerful and most rapid antipyretic which we possess,—but it has not been employed to any great extent since the advent of Antipyrine.

* THALLINA,—Thalline.

Source and Composition. Thalline is a synthetically prepared alkaloid, having the chemical name *Tetra-hydro-paramethyl-oxy-chinoline.* It occurs as a colorless powder, which is soluble in water, and enters into combination with acids, forming salts, of which the tartrate and sulphate are the most eligible, especially the latter.

Dose and Administration. The dose of Thalline or its Sulphate ranges from gr. ij to gr. xv, a mean average dose being about 5 grains, given in the form of compressed tablets.

Physiological Action and Therapeutics. Thalline is an antipyretic of very great power, doses of 5 to 12 grains lowering the temperature in typhoid fever 4° to 5°, in 2 hours' time, the effect lasting nearly 3 hours. In tuberculosis similar results were obtained. Large doses, however, produce very profuse sweating and a dangerous degree of depression; so that this agent is not a favorite remedy for hyperpyrexia.

* NAPHTHALINA,—Naphthaline.

Source and Composition. Naphthaline, $C_{10}H_8$, is one of the benzene derivatives, (see page 179), formed by the union of two benzene groups. It occurs as colorless, micaceous crystals, obtained from the destructive distillation of coal-tar, having a peculiar smell,—insoluble in water, dilute acids or alkalies, and but sparingly so in alcohol.

The Dose of Naphthaline is from gr. ij–gr. viij, up to gr. lxxx per diem for adults;—and for children gr. j–gr. iij, every 3 hours. Being quite insoluble in water it must be given in emulsion, or as a powder with sugar in wafers or capsules. It is best flavored with oil of bergamot.

Derivatives. From Naphthaline we have—

* *Naphthol*, $C_{10}H_7OH$, Beta- or Iso-naphthol,—one of several kinds of Naphthol: is sparingly soluble even in hot water, but is soluble in alcohol, ether, chloroform, olive oil and vaseline. Used as ointment, 1 to 5 for adults, but for children not over 2 per cent.

* *Hydronaphthol*, $C_{16}H_7OH$,—glistening, micaceous scales, sparingly soluble in water, freely soluble in alcohol, oils, etc. Used as an antiseptic, and in ointment or powder locally, diluted with oxide of zinc, 1 to 50.

Physiological Actions. *Naphthaline* is destructive to all forms of low life, and hence is antiseptic in a high degree, but must be intimately mixed with the substances upon which it is to act. Internally it is a stimulant expectorant of decided power, and disinfects the contents of the intestinal canal. Being so sparingly soluble, but little of it is absorbed, and hence it does no injury to the organism. What is taken up by the blood is excreted by the urine, partly unchanged, partly as naphthol and perhaps some as phenol. *Naphthol* is more easily absorbed, and causes vomiting, hematuria, convulsions, and unconsciousness. *Hydronaphthol* is a powerful and non-irritating antiseptic, non-poisonous, non-corrosive, freely soluble in alcohol, glycerin, fixed oils, etc., in cold water, 1 to 2000; and in hot water 1 to 100, precipitating as the water cools, but leaving a saturated solution of 1 to 1000, which is perfectly inhibitive of the germs of putrefaction in all putrescible fluids (Levis). The claims made for it are that it is 12 times as effective as carbolic acid, 30 times as potent as salicylic acid, 60 times as efficient as boric acid, 600 times as antiseptic as alcohol, and that it is entitled, as a true antiseptic, to stand next to mercuric chloride in the comparative tables (Levis)

Therapeutics. *Naphthaline* is employed as an antiseptic for the intestinal canal in typhoid fever, diarrhœa, both acute and chronic, tubercular diarrhœa, etc. It renders the urine aseptic and may be employed in vesical catarrh. It is also used internally for humoral asthma, verminous affections, and the chronic pulmonary catarrh of the aged. Locally, it has high value as an antiseptic, for indolent ulcers, sloughing wounds, open cancers, pus cavities, etc. Painted over organic remains it effectually prevents the ravages of insects. *Naphthol* is employed like tar for a therapeutic action upon the skin, in hyperidrosis, scabies, eczema and local sweating, in ½ to 5 per cent. alcoholic solution, or as a 10 per cent. ointment. *Hydronaphthol* is also highly esteemed for antiseptic purposes generally, by those who have used it, and is of benefit as an external application in many skin diseases. Its non-toxic and non-irritant qualities render it the most useful and most generally available of the three.

*SACCHARINA,—Saccharine.

Source and Composition. Saccharine is a recently discovered derivative of a coal-tar product, *Toluene*, from which it is prepared by a complicated process. It has the chemical title *Benzoyl-sulphonic-imide*, and the formula $C_6H_4(CO)(SO_2)NH$. It occurs as a white amorphous powder, with a very sweet taste, and a faint flavor of bitter almonds, soluble in alcohol and in ether, [Sugar is *not* soluble in ether], sparingly in cold water, more so in hot water.

Physiological Action and Therapeutics. Saccharine is 220 times sweeter than sugar to the taste, and is also an efficient antiseptic. It is not a food, like sugar; and has no injurious action on man. It may prove of use as a substitute for sugar in cases of diabetes, but it has no curative action upon that disease.

CARBOLIC ACID,—Phenol.

Acidum Carbolicum, Carbolic Acid, Phenylic Alcohol, Phenol, C_6H_5HO, or C_6H_6O:—is a product of the distillation of coal-tar between the temperatures of 356° and 374° F. It is not an acid, as it does not redden blue litmus-paper, but a member of the aromatic series of carbon compounds, resembling alcohol in its constitution;—being formed by substituting the radical hydroxyl for one atom of hydrogen in Benzene. [See page 179]. Dose, ♏j–iij.

Acidum Carbolicum Crudum, Crude Carbolic Acid,—is a liquid obtained during the distillation of coal-tar between the temperatures of 338° and 374° F., and containing Carbolic and Cresylic Acids in variable proportions, together with other substances.

Carbolic Acid occurs in colorless or pinkish, acicular crystals, which deliquesce on exposure to the air, into an oily liquid, of distinctive, aromatic odor, resembling creasote, and a neutral reaction. It is freely soluble in alcohol, ether, chloroform, glycerin, oils, etc., and in 20 parts of water. Of the crystals 100 parts are liquefied by adding 5 parts of water; then the further addition of water renders the liquid turbid, until 2000 parts have been added, when a stable and clear solution is formed. Carbolic Acid coagulates albumen or collodion, (difference from Creasote); and by the action of nitric acid it is converted into picric acid, (Creasote into oxalic acid).

Preparations. Only one is official, viz. :—

Unguentum Acidi Carbolici, Carbolic Acid Ointment,—10 per cent.

**Glyceritum Acidi Carbolici,* Glycerite of Carbolic Acid,—1 to 4 of Glycerin by measure, equals 1 to 6 by weight.

**Liquor Acidi Carbolici,* Solution of Carbolic Acid,—for local use in antiseptic surgery, of various proportions in water, 2½ per cent. for sponges, hands, etc., 5 per cent. as spray, etc.

Derivatives. One is official, viz :—

Sodii Sulpho-carbolas, Sulpho-carbolate of Sodium,—prepared by dissolving Carbolic Acid in an equal part of strong Sulphuric Acid, to form Sulpho-carbolic Acid, and neutralizing this with Sodium Carbonate. Transparent, rhombic prisms, soluble in 5 of water, less freely in alcohol and glycerin. Dose, gr. x–xxx.

**Salol,* Salicylate of Phenol,—see under SALICIN, (next title).

Analogues of Carbolic Acid.

Creasotum, Creasote,—is " a product of the distillation of wood-tar " (U. S. P.): an exceedingly complex substance, containing many hydrocarbons, several of which are closely allied to Carbolic acid. Dose, ♏j–iij.

A colorless or yellowish, oily liquid, of strongly empyreumatic odor, burning and caustic taste, and neutral reaction; freely soluble in alcohol, ether, acetic acid, etc., sparingly in water (1 in 80), more readily in boiling water, (1 in 12). It does not coagulate albumen or collodion (difference from Carbolic acid, which does). By the action of nitric acid it is converted into oxalic acid chiefly, (Carbolic into picric acid).

Aqua Creasoti, Creasote water,—strength 1 per cent.; is the only official preparation. Dose, ʒj–ʒiv.

***Resorcin,** Meta-di-hydroxy-benzene, $C_6H_4(OH)_2$,—is one of the three isomeric substances formed by substituting two atoms of hydroxyl for two of hydrogen in Benzene, as the substitution of one produces Carbolic acid. The relative positions of the hydroxyl atoms in the ring are for Resorcin 1 and 3, for Pyrocatechin 1 and 2, and for Hydroquinone 1 and 4, the two latter having the respective prefixes " Ortho," and " Para," with the composition name, " Di-hydroxy-benzene," and the same formula as Resorcin.

Resorcin occurs in white, crystalline plates, resembling benzoic acid, having a harsh but sweetish taste, no odor and neutral reaction. It is soluble in less than two parts of water, and in 20 of olive oil; also in alcohol, ether, etc. Dose, gr. v-xxx, with syrup of orange, and well diluted;—as an antipyretic, gr. v every two hours, or ʒj not repeated for several hours.

Hydroquinone occurs in plates of sweetish taste, and is about four times stronger than Resorcin, having the same action and uses.

Pyrocatechin also occurs in plates or crystals, is three times stronger than Resorcin, but otherwise the same; is readily soluble in water, alcohol and ether, and reduces cupric sulphate.

***Pyrogallic Acid**, Pyrogallol, Tri-hydroxy-benzene, $C_6H_3(OH)_3$—has the same form of composition as the preceding substances, except that it has 3 atoms of Hydroxyl substituted for 3 of Hydrogen in the Benzene-ring, instead of 1 as in Carbolic Acid, and 2 as in Resorcin. (See page 179, *ante*). It is prepared by heating gallic acid, and occurs in light, glistening crystals, which are readily soluble in water and in alcohol, and combine rapidly with oxygen, becoming of a dark color. Dose, gr. ss to gr. iss.

Physiological Action. *Carbolic Acid* is a powerful antiseptic and anti-ferment, deodorizer and disinfectant, being very destructive to low forms of life when used in sufficient strength. It prevents the decomposition of albuminous fluids by bacteria, the fermentation of sugar by yeast, the conversion of starch into sugar, of albumen into peptones, and the decomposition of amygdalin with formation of hydrocyanic acid. (Brunton). As ordinarily used in solutions its action upon low organisms is inhibitive rather than destructive, its safe solutions being only sufficient to prevent their development. Locally it is styptic, anæsthetic and superficially escharotic, coagulating the albumen of the part, and the blood also when outside the body. Swallowed undiluted it produces violent gastro-enteritis, with vomiting and purging, followed by collapse, delirium, and often by convulsions and death. It is powerfully poisonous to the tissues, and when applied directly to muscle or nerve, it paralyzes them at once without previous stimulation. When absorbed it acts by selection upon the medulla, especially on the respiratory and vaso-motor centres therein, which it first briefly stimulates and then completely paralyzes.

It stimulates the cardiac inhibition, first slowing the heart, then depressing and finally paralyzing it. Respiration, at first increased, is soon depressed, the pupils are contracted, and the brain and spinal cord are directly affected,—stupor, coma, suspended reflexes, impaired motility and sensibility being produced. It is rapidly absorbed and diffused, many fatal cases having occurred from its local use in full strength. It is partly oxidized in the body, and partly eliminated by the lungs and kidneys, imparting to the urine a smoky appearance. ♏vj of the pure acid have produced dangerous symptoms. Death from a medium dose occurs by paralysis of respiration, from a large dose by paralysis of the heart. The blood, after death, is very dark in color, and is almost non-coagulable.

Creasote has similar properties, but is not so actively toxic as carbolic acid; it causes increased coagulability of the blood, and does not produce convulsions. It is largely eliminated by the bronchial mucous membrane which it stimulates, and is therefore a good expectorant. In small doses it seems to have a selective sedative influence on the terminal nerve-filaments in the gastric mucous membrane. It explodes when combined with Oxide of Silver in pill, unless previously diluted with an inert powder.

Resorcin is not irritant to the skin or the submucous tissue, and but slightly so to mucous membranes. It is equally powerful as an antiseptic and antiferment, arresting decomposition and destroying low organisms. ʒss to ʒj causes a sense of heat, discomfort and oppression, followed by profuse perspiration and languor; if fever has existed the temperature is lowered several degrees, but rises again, after a rigor, in from two to four hours.

Hydroquinone and *Pyrocatechin* have similar properties to those of Resorcin, but they are several times stronger and correspondingly more active.

Pyrogallic Acid is exceedingly poisonous, the symptoms coming on in rapid succession, with headache, vomiting and purging, collapse, etc. It decomposes the red blood-corpuscles, causing thrombi in the venous radicles, hemorrhagic infarcts in the kidneys, and hematuria, also melanæmic discoloration of the skin and mucous membranes. Its antiseptic action is doubtful.

Antidotes and Antagonists to Carbolic Acid. *Magnesium* or *Sodium Sulphate* to form a Sulpho-carbolate, and the official *Syrupus Calcis*, given freely, are the chemical antidotes. *Atropine* is said to be a very complete physiological antagonist, maintaining the heart and respiration until elimination occurs, which should be promoted by diluents, used freely. *Vegetable Demulcents*, (but no oils or glycerin), to protect the mucous surfaces. *Cider Vinegar* removes the local effects of the application of the strong acid, and may prove a good antidote. *Magnesium Sulphate* used in one case, (nearly 3 ounces), where half-an-ounce of 95 per cent. acid had been swallowed, with full recovery from an all but hopeless condition of collapse.

Therapeutics. CARBOLIC ACID owes its past prominence to its having been the principal agent used in Lister's Antiseptic Method; but its use in that connection is now almost abandoned, most of the authorities believing that it does more harm than good in the dilute solutions which alone are safe. In ¼ grain doses it is an excellent remedy for *Nausea and Vomiting*, and may be advantageously administered in dilute solution (2 to 5 per cent.) by spray, in many chronic pulmonary affections; also locally and by injection in—

Catarrhs,—acute and chronic.
Parasitic Skin Diseases.
Uterine and other *Ulcers.*
Erysipelas.
Synovitis.
Hydrocele.
Endo-metritis.
Abscesses.
Pulmonary Phthisis.

Exanthematous Fevers, and other Septic diseases,—the Sulpho-carbolate of Sodium internally in 5-grain doses every two or three hours, has been much praised by many practitioners.

CREASOTE is more suitable for internal administration, and is used with benefit for *vomiting* from many causes, that due to abnormal gastric fermentation, ulceration of the stomach, cancer, sea-sickness, Bright's disease, and even pregnancy. It is also useful in the *irritative diarrhœa* of children, and its vapor is well employed by inhalation in *phthisis* and *bronchitis*.

RESORCIN has been used as a local antiseptic in *diphtheria*, cystitis, facial erysipelas and syphilitic sores; also in 5-grain doses internally to prevent gastric fermentation. As an antipyretic it has been employed in *typhoid fever* and in *phthisis*, but its short antipyretic power, and the profuse perspirations which it induces, are objections to its ever being a favorite remedy.

PYROGALLOL is employed locally in skin diseases; a 20 per cent. ointment being used as a caustic in lupus, cancer and chancres. It is said to destroy the diseased tissue without affecting the healthy tissue in the vicinity. (Brunton). A 10 per cent. ointment is applied in psoriasis, lupus erythematosus, etc., but the dangers of absorption must be borne in mind.

SALICIN AND SALICYLIC ACID.

Salicin $C_{13}H_{18}O_7$ is a crystalline glucoside, consisting of *Saligenin* and glucose; found in Gaultheria procumbens (Wintergreen), and in the bark of several species of Salix (willow). **Salicylic Acid** $HC_7H_5O_3$ is a derivative of Salicin, probably by double oxidation; but may also be considered as a substitution-derivative of Benzene, formed by replacing 2 atoms of its hydrogen, the one by hydroxyl, and the other by carboxyl. (See page 179, *ante*). It is obtained therefore, either synthetically by combining the elements of Carbolic Acid with those of Carbonic Acid, and subsequent purification,—or from natural salicylates as the oils of wintergreen and sweet-birch,—or from salicin, by heating with caustic potash and treating the mass with hydrochloric acid. The acid prepared from natural sources is purer and more efficient than that prepared artificially, and will often be tolerated by a patient who cannot bear the latter.

Salicinum, Salicin, Dose, gr. xx–ʒij. Soluble in 28 of water.

Acidum Salicylicum, Salicylic Acid, Dose, gr. v–ʒj. Soluble in 450 of water and in 2½ of alcohol, but 10 parts may be dissolved in 100 of water by the aid of 8 parts of Borax, or Sodium Phosphate 10.

Preparations.

Sodii Salicylas, Salicylate of Sodium, Dose gr. v–ʒj. } Soluble in water.
Lithii Salicylas, Salicylate of Lithium, Dose gr. v–ʒj. }

Physostigminæ Salicylas, Salicylate of Physostigmine, Dose gr. $\frac{1}{100}$–$\frac{1}{60}$.

Oleum Gaultheriæ, Oil of Wintergreen, Dose ♏v–xv.

**Salol*, Salicylate of Phenol,—consists of 60 parts by weight of Salicylic Acid and 40 of Carbolic Acid. Is insoluble in water, almost tasteless and odorless. Dose, gr. v–ʒj, in compressed tablet.

Physiological Actions. *Salicin* is a bitter tonic, an antipyretic, antiferment, and antiseptic, being destructive to low organisms. It prevents the reaction between amygdalin and emulsin, and that of ptyalin on starch. It seems to be devoid of toxic power on man, and is probably excreted as Salicylic and Salicyluric acids. It has some slight power as an antiperiodic.

Salicylic Acid has properties similar to the above, but acts with greater energy. In small doses it stimulates the stomach, heart and respiration, but large doses derange the stomach, causing nausea and vomiting, depress the heart and respiration, lower the arterial tension, and reduce the temperature in fever. It causes vertigo, dilated pupils, tinnitus aurium, a sensation of tension in the frontal cerebrum, delirium, and occasionally collapse, from sudden depression of the circulation. A lethal dose produces death by paralysis of the respiration. During its administration bed-sores are frequently observed, being due to the depressed state of the circulation which it induces. During its excretion it often irritates the kidneys and causes albuminuria. It colors the urine green by transmitted and brown by reflected light, and under its use the urine contains a substance which reduces copper solution—(Brunton).

Salicylic Acid is destructive to the torula, prevents alcoholic fermentation, also that caused by the organic ferments, (pepsin, ptyalin, etc.). In solutions containing bacteria, it will prevent their development, if in the proportion of 1 per cent.; and in that of 1 in 60 it will destroy them when in full activity.

Salicylate of Sodium is remarkably antipyretic in doses of gr. xv, given 4 or 5 times in 24 hours. It is a powerful diaphoretic, and an efficient cholagogue, and it is supposed to possess the curious property of increasing the fluidity of the bile, at the same time that it promotes its secretion,—other cholagogues increasing the proportion of solids therein. (Brunton). It has no antiseptic power unless in association with a strong mineral acid, which will liberate the salicylic acid.

Salol is antiseptic, antipyretic and germicide, in a higher degree than either of its constituents. As an antipyretic in fever it stands next after Antipyrine, and it acts with such force as to frequently depress the temperature a degree or two below normal. It is sedative to the cerebro-spinal system, and somewhat analgesic. It causes profuse sweating, and in a few cases considerable depression has accompanied its antipyretic employment; but it is not toxic, and may be used freely in its proper dosage, which ranges from 5 to 60 grains, up to 2 or 3 drachms in the 24 hours.

Therapeutics. SALICIN and its derivatives are chiefly used in *Acute Rheumatism*, to lower temperature, relieve pain, and reduce articular swelling. They are most suitable to strong, vigorous patients, and if not promptly efficient they should be abandoned. SALICYLIC ACID is much used as an antipyretic in fevers, especially those of the septicæmic kind. It is a useful application to *Corns* and *Warts*, also in—

Eczema of hands and feet. *Cancer.* *Fetid Perspirations*, in which it is
Gangrenous *Wounds.* *Burns.* used in solution with Borax.

SALICYLATE OF SODIUM is employed in 3 to 5-grain doses internally after meals, to arrest gastric fermentation, and to prevent acidity and flatulence. It is used instead of the acid in acute and chronic *rheumatism*, to relieve *headaches*, and for *phlegmasia alba*, in which it is considered very efficient,—also in cases where there is a tendency to the formation of *gall-stones*.

SALOL is a most efficient remedy for *duodenal catarrh*, catarrh of the bile-ducts and catarrhal jaundice; also in the *bilious* form of *sick-headache*, and in some forms of *neuralgia*. Its greatest power is manifested over *acute rheumatism*, in which disease many clinicians maintain that it has no superior, if given in 15 to 30-grain doses, up to 2 drachms in the 24 hours, and continued for some time after the acute symptoms have subsided. It should prove an efficient disinfectant in *catarrh of the bladder*, as its constituents are excreted with the urine, and come in contact with the vesical mucous membrane for a considerable period of time.

THYMOL AND MENTHOL.

Thymol, $C_{10}H_{13}HO$,—is "a stearoptene obtained from the volatile oils of *Thymus vulgaris*, *Monarda punctata*, and *Carum Ajowan*," (B. P.), which oils contain Thymol and Thymene, $C_{10}H_{16}$, the latter being fluid. The oil of Thyme is official. (See page 194.)

Thymol occurs in large, prismatic crystals, having the odor of thyme, and a pungent, aromatic flavor. They sink in cold water, but if the mixture be heated to 110°–125° F. they melt and rise to the surface; and volatilize completely at the temperature of a water-bath. Soluble in alcohol, ether, and solutions of alkalies, but slightly so in cold water.

Dose of Thymol, internally gr. ss–gr. ij;—as a spray 1 part in 800 of hot water;—as ointment, gr. v-xxx to the ℥ of petrolatum;—as inhalation, gr. vj to ℥j of warm water.

* **Menthol**, or Peppermint Camphor, $C_{10}H_{20}O$,—is "a stearoptene obtained by cooling the oil distilled from the fresh herb of *Mentha arvensis* and of *Mentha piperita*." (B. P.);—the latter plant and its oil being official in the U. S. P. though Menthol itself is not.

Menthol occurs in colorless crystals or masses, having the taste and smell of peppermint oil, soluble in alcohol, ether, etc., but sparingly in water. It forms an oily liquid when rubbed up with an equal quantity of thymol, pure carbolic acid, or chloral hydrate, or ⅛ of croton-chloral, or ⅔rds of camphor.

Dose of Menthol, gr. ss–gr. ij.

Mints and their Preparations.

Mentha Piperita, Pepper-mint,—the leaves and tops of *Mentha piperita*, a plant of the ord. Labiatæ, cultivated everywhere.

Oleum Menthæ Piperitæ, Oil of Peppermint,—is the volatile oil distilled from the fresh herb, consisting of Menthol (see above), and a liquid terpene. Dose, ♏j–v.

Aqua Menthæ Piperitæ, Peppermint Water,—2 per 1000. Dose, ad lib.

Spiritus Menthæ Piperitæ, Essence of Peppermint,—10 per cent. of the oil and 1 per cent. of the powdered herb. Dose, ♏x–xxx.

Trochisci Menthæ Piperitæ, Peppermint Troches,—each has of the oil gr. $\frac{15}{100}$, with Sugar and Mucilage. Dose, ad lib.

Mentha Viridis, Spearmint,—the leaves and tops of *Mentha viridis*, the well-known "mint" of the gardens, a cultivated plant of the ord. Labiatæ, having properties and constituents identical with those of Peppermint, but differing therefrom in odor and taste. Its preparations are as follows,—

Oleum Menthæ Viridis, Oil of Spearmint,—Dose, ♏ij–v.

Aqua Menthæ Viridis, Spearmint Water,—Dose, indefinite.

Spiritus Menthæ Viridis, Essence of Spearmint,—Dose, ♏x–xl.

Physiological Actions. *The Mints* are aromatic stimulants, carminatives and antispasmodics, their oils possessing these qualities in greater degree, and being also local anodynes and anæsthetics, especially if their evaporation be prevented after their application to a surface. The Chinese oil is especially efficient as an anodyne, and contains a large quantity of Menthol.

Menthol acts as a local vascular stimulant when applied to the skin; and is also a local anæsthetic, but not corrosive, causing first a sensation of burning, which is replaced by a feeling of coldness when the part is blown upon. It is a powerful antiseptic, the oil of peppermint being found to destroy comma bacilli in solution of 1 to 2000;—but its slight solubility in water prevents its use becoming general in this respect. Administered internally it stimulates the secretory nerves and the cardiac muscle, and causes a periodic increase in arterial tension (like camphor), but does not affect the pulse-rate. It increases the respiratory rate, and lessens the depth of the respirations. It lessens sensation and reflex sensibility, in large doses destroying both, and paralyzing the cerebro-spinal system.

Thymol resembles both carbolic acid and oil of turpentine in its action, being a powerful antiseptic and germicide, like the former,—and an irritant to the organs of elimination and a paralyzant like the latter. When absorbed in toxic quantity it paralyzes the nerve-centres in the spinal cord and medulla from the first, with no preliminary stimulation;—slowing respiration, lowering the arterial tension, blood-pressure and body-temperature, and lessening reflex excitability. It is eliminated by the urinary and respiratory organs, which it irritates during its excretion. Autopsies on animals poisoned by it show fatty degeneration of the liver, (as with phosphorus), and great congestion of the bronchial and pulmonary mucous membranes and of the kidneys.

Therapeutics. The *Oils of the Mints* are employed chiefly as carminatives and stimulants, to relieve flatulence and colic; also as a corrigent to purgatives, to lessen griping. *Menthol* is used locally as an antiseptic and analgesic, and *Thymol* as an antiseptic application to wounds and skin-diseases, also as a spray or inhalation in chronic affections of the lungs and bronchi.

Insects, as mosquitoes, gnats, etc.,—are effectually repelled by the odor of the oils of mint, and attracted by that of thyme.

Neuralgia, *Odontalgia*, etc.,—are relieved by the application of the menthol pencil over the surface, or the oily liquid resulting from its trituration with chloral, camphor, etc. on cotton in the cavity of a carious tooth.

Diabetes and *Cystitis* have been treated with Thymol, as an internal remedy; —also *Phthisis*, *Diphtheria*, and *Typhoid Fever*.

Intestinal Affections, and ulcerated conditions of the *mouth* and *fauces*,—are satisfactorily treated with Thymol, as an internal antiseptic and mouth-wash.

ANTISEPTIC OILS.

Oleum Caryophylli, Oil of Cloves,—contains the *Light and Heavy Oils of Cloves*, the latter containing *Eugenol*, and *Caryophyllin*—a camphor, also *Caryophyllic and Salicylic Acids*. Dose, gtt. ij–v.

Oleum Gaultheriæ, Oil of Wintergreen,—consists of *Methyl Salicylate*, 90 per cent., and *Gaultherilen*, a hydro-carbon, 10 per cent. Dose, gtt. v–x.

Oleum Cajuputi, Oil of Cajuput,—contains *Cajuputol* or the *Bihydrate of Cajuputene*, ⅔; the other ⅓ being another oil. Dose, gr. v–xx.

Oleum Eucalypti, Oil of Eucalyptus,—contains a volatile oil which consists of *Eucalyptol*, an oxygenated oil, and two other products named *Turpene* and *Cymol*. [See *ante*, page 60.] Dose, ♏ij–xx.

Oleum Thymi, Oil of Thyme,—contains *Thymol* or *Thymic Acid*, which is a crystalline body homologous with Phenol,—also a hydro-carbon which is resolvable into *Cymene* and *Thymene*. [See *ante*, page 192.] Dose, ♏j–iij.

***Oleum Myrti**, Oil of Myrtle,—a volatile oil distilled from the leaves of *Myrtus communis*, the myrtle, nat. ord. Myrtaceæ. Dose, ♏j–iij, in capsule. It contains *Myrtol*, isomeric with oil of turpentine.

Physiological Action. The general action of these oils and their derivatives agrees with that of Thymol. *Myrtol* is a very active antiseptic and parasiticide, and sufficiently irritant on a raw surface to excite inflammation. It is eliminated by the lungs and kidneys, acting as a stimulating expectorant, and as an antiseptic and stimulant to the mucous membranes at the points of elimination. *Eucalyptol* is one of the most powerful antiseptics, and the *Oil of Eucalyptus* is nearly as efficient, either of them ranking above Quinine in hindering the development of anthrax bacilli. (Koch). It is a local irritant, and if applied to the skin, and its evaporation prevented, it acts as a vesicant or as a pustulant. In the stomach it is highly irritant, doses of 20 minims causing burning sensations and great pain. Absorbed in large quantity it is a powerful poison to the nerve-centres, depressing the spinal cord, brain, medulla and heart, abolishing reflex action, lowering the blood-pressure and temperature, and causing death by paralysis of respiration. It is excreted by the pulmonary and renal mucous membranes, imparting a smell of violets to the urine, acting as a stimulating expectorant and a renal and urinary antiseptic. It arrests the movements of the white blood corpuscles, causes contraction of the spleen, and has considerable power as an antiperiodic, in all of which qualities it resembles Quinine, though much less efficient.

Therapeutics. These oils are not as much used in medicine as they deserve to be. *The Oil of Cloves* is often employed in domestic practice, as a local anæsthetic in toothache and superficial neuralgia. Dissolved in alcohol, any of these oils will promptly correct flatulence, if administered internally, in small doses. Their most important applications are in the following affections, viz:—

Bronchorrhœa, fetid bronchitis, gangrene of the lung, etc.,—Myrtol is an efficient disinfectant and alterative.

Choleraic Vomiting, and that due to nervous derangement,—the Oil of Cajuput, with Spt. Chloroformi, and Tinct. Cinnamomi.

Parasitic Skin-diseases,—favus, herpes and pityriasis, are cured by Myrtol; and Cajuput Oil is a very effective local application in tinea, scabies, pityriasis, etc.

Worms, both ascarides and the round worm,—are effectually expelled by Myrtol or Cajuput Oil, as enemata.

Rheumatism, *Gout*, and allied affections,—are exceedingly well treated by Oil of Gaultheria, in emulsion with other similarly acting agents.

Cystitis and *Urethritis*,—Myrtol and Eucalyptol are used with benefit, administered internally so as to act on these mucous membranes through the urine.

Septicæmia and *Pyæmia*,—the oil of Eucalyptus has been used successfully; especially in three cases of septicæmia, in one of which Quinine had proved useless. (Brunton).

Uterine Catarrh, and after parturition,—Oil of Eucalyptus is well used as injection or on pessaries.

Sponge-tents are most effectually disinfected and deodorized by being dipped into Oil of Cloves.

BENZOIN AND BENZOIC ACID.

Benzoinum, Benzoin,—is a balsamic resin obtained from *Styrax Benzoin*, a tree of the nat. ord. Styraceæ. It occurs in lumps of agglutinated tears, or a brownish mass, of little taste, but agreeable odor, soluble in alcohol and solution of potassa; and consists of *Benzoic Acid*, 14 per cent., together with *Resins*, 80 per cent., and a trace of a volatile oil. Dose, gr. x–xxx.

Acidum Benzoicum, Benzoic Acid, $HC_7H_5O_2$,—occurs in light, feathery plates and needles, and is obtained from Benzoin by sublimation. Soluble in 3 of alcohol, and in 500 of water; but with Borax 1 part of each are soluble in 100 of water. Dose, gr. x–xx.

Preparations, including the salts of Benzoic Acid, or Benzoates.

Adeps Benzoinatus, Benzoinated Lard,—has of Benzoin 2 per cent.

Tinctura Benzoini, Tincture of Benzoin,—20 per cent. Dose, ʒ ss–j.

Tinctura Benzoini Composita, Compound Tincture of Benzoin, Friar's Balsam,—has of Benzoin 12, Aloes 2, Styrax 8, Balsam of Tolu 4, and Alcohol to 100 parts. Dose, ʒ ss–ij, but generally used locally.

Ammonii Benzoas, Benzoate of Ammonium,—soluble in 5 of water, and in 28 of alcohol. Dose, gr. v–xxx.

Lithii Benzoas, Benzoate of Lithium,—soluble in 4 of water, and in 12 of alcohol. Dose, gr. v–xxx.

Sodii Benzoas, Benzoate of Sodium,—soluble in 2 of water, and in 45 of alcohol. Dose, gr. v–ʒj. Is efflorescent.

Physiological Action. The action of Benzoin is due to *Benzoic Acid*, which is stimulant and irritant to mucous membranes and raw surfaces, also highly antiseptic and disinfectant, a stimulating expectorant, and a diuretic. Taken internally it causes epigastric heat, increases the pulse-rate, and stimulates the action of the skin, the salivary glands, and the bronchial mucous membrane. It acidifies the urine, and increases its quantity, and is chiefly excreted by the kidneys, in part unchanged, and partly as hippuric acid after uniting with glycocoll. Benzoin acts as an irritant to the mucous membrane of the fauces and nasal passages; its powder inhaled causing sneezing and coughing.

Therapeutics. The uses of *Benzoin* and *Benzoic Acid* are chiefly local, but they may be used with benefit internally in several affections of the respiratory and urinary passages. In—

Chronic Bronchitis of the aged,—Benzoin as a stimulating expectorant.

Laryngeal and *Bronchial* affections,—Benzoin by steam atomization.

Chlorosis and several *Uterine* disorders,—Benzoin internally, of benefit.

Chaps and *Sore Nipples*,—the compound tincture 1, to 4 of glycerin and water.

Freckles, etc.,—either tincture with 20 of water, locally as a cosmetic.

Wounds of foul character,—the tinctures are excellent applications.

Cystitis with alkaline urine and phosphatic deposits,—Benzoic Acid or its salts are extremely valuable, being the only certain means of neutralizing morbid alkalinity of the urine.

Phosphatic Calculi,—a long course of the Ammonium Benzoate.

Gout and *Uric Acid Diathesis*,—the Lithium Benzoate very efficient.

Diphtheria, *Scarlet Fever*, and other septic diseases,—the Sodium Benzoate largely used instead of the salicylates, as an internal antiseptic and antipyretic, and has rendered good service.

Phthisis and *Whooping-cough*,—the Sodium salt by inhalation with atomizer.

CHLORUM,—Chlorine.

Chlorine, Cl,—is a greenish-yellow gas, belonging to the *Halogen* group of elements; and though not official itself, it is represented in medicine by several of its compounds, as well as by several preparations which furnish it.

The so-called *Halogen Elements* derive their title from ἅλς, the sea,—because the most important members of the group are obtained, directly or indirectly, from the ocean, viz;—*Chlorine*, from sea-salt; *Bromine*, from sea-water; and *Iodine*, from sea-weed. They are all noted for their affinity for hydrogen, and consequent power as decomposers of organic matter.

Chlorine Compounds, described under the titles of their respective bases, are—the *Chlorates* of Potassium and Sodium,—the *Chlorides* of Ammonium, Calcium, Potassium, Sodium, Mercury, Gold, Iron and Zinc, etc.,—also *Hydrochloric Acid*, classed with the mineral acids, on page 48; and Chloral, Croton-chloral, and Chloroform.

Preparations.

Aqua Chlori, Chlorine Water,—is an aqueous solution, containing at least $\frac{4}{10}$ per cent. of the gas. Dose, ♏x-xx, in water. For local use ʒj–℥j well diluted, as a lotion or spray.

Calx Chlorata, Chlorinated Lime, Chloride of Lime, (not Chloride of Calcium),—contains at least 25 per cent. of available Chlorine. Dose, gr. iij–vj in water;—externally a 1 to 3 per cent. solution.

*_Liquor Calcis Chloratæ_, Solution of Chlorinated Lime, (B. P.),—has of the preceding 1 pound in 1 gallon of Water.

Liquor Sodæ Chloratæ, Solution of Chlorinated Soda, Labarraque's Solution,—contains Hypochlorite of Sodium, with Chloride of Sodium. Dose, ♏x–ʒj, in 20 parts of water.

Physiological Action. Chlorine is the most powerful of all the disinfectants and deodorants, and an antiseptic and antifermentive agent of the highest activity; its power in these respects being due to its affinity for hydrogen, decomposing all bodies which contain hydrogen as a molecular constituent, forming hydrochloric acid and setting oxygen free in its nascent form (ozone). Administered internally, it is converted, on reaching the stomach, into hydrochloric acid and chlorides, losing all action on the organism in its own character. Locally applied, it is an active irritant to the skin and mucous membranes, producing a sense of heat, with burning sensations and even vesication. Inhaled in any quantity, it causes cough, sneezing, and spasm of the glottis, also inflammation of the mucous lining of the air-passages, and of the lungs.

The *Chlorides* generally resemble, in their actions, their basic constituents rather than Chlorine; but one of them possesses qualities of its own which render it of prime importance, namely, *Sodium Chloride*, or Common Salt. This substance is one of the most important and abundant of the saline constituents of the animal organism, existing normally in the blood, where it keeps the fibrin and albumin in solution; hence in inflammation, being thus needed, it accumulates at the seat of the morbid action, disappearing temporarily from the urine; its reappearance therein being considered one of the surest signs of the patient's improvement. In very dilute solution it enables water to dissolve both albumins and globulins, and renders water non-irritant to the animal tissues and harmless to the red blood-corpuscles. For these purposes the solution employed is one of 0.65 per cent., known in experimental physiology as the "normal salt solution." In substance, however, or in concentrated solution, it is very irritant to cut surfaces, mucous membranes muscle and nerve tissues. Taken into the stomach in quantity it irritates that organ, and induces vomiting; and, when absorbed in excess of the normal requirements of the body, it causes, in great intensity, the peculiar nervous irritation which is expressed by the sense of *thirst;* and this is only relieved by the ingestion of water in sufficient quantity to enable the excess to be dissolved and excreted by the kidneys. It is rapidly absorbed, and equally rapidly excreted; and, when consumed in excess, it increases tissue-change, and consequently the excretion of urea,—and also the excretion of potassium salts. On the other hand, the excessive ingestion of potassium salts, (as in the cases of herbivorous animals, and vegetarian cranks,) increases the excretion of sodium chloride, by a double decomposition between them in the blood, forming potassium chloride and sodium phosphate, which, being foreign to the blood, are constantly excreted. In this way, by a continuous vegetable diet, the normal amount of sodium chloride in the organism may be greatly reduced; and the animal will feel the want of it, and will travel hundreds of miles to visit a salt-lick. (Brunton).

Besides being emetic, when given internally, *Sodium Chloride* also acts as a hemostatic, decreases the secretion of mucus, is a vermifuge against ascarides, promotes the absorption of pleuritic serous exudations and of dropsies, and has considerable power as an antiperiodic and an antiseptic.

Ammonium Chloride is alterative, expectorant, cholagogue, and purgative, also anti-neuralgic, and refrigerant,—the latter property being exhibited when locally used, as by the process of its being dissolved in water a considerable degree of cold is produced.

Chloride of Iron is one of the most valuable compounds of that metal, with which it is generally classed,—its action being mainly that of a chalybeate. Being a chloride, however, it must possess high antiseptic energy in the organism;—and it is doubtless the combination, in this agent, of the quality of an active, yet safe internal antiseptic, with its power as a blood-restorer, which makes it so valuable a remedy in the septic diseases.

[The other Chlorides (of Mercury, Gold, Zinc, etc.) and the Chlorates of Potassium and Sodium, are described under the titles of their respective bases.]

Antidotes. Ammoniacal vapors inhaled to form Ammonium Chloride. *Albumen* if Chlorine preparations have been taken into the stomach; also a little *Aqua Ammoniæ* sufficiently diluted, may be given with advantage.

Therapeutics. The Chlorinated preparations are used as disinfectants and deodorizers of rooms, drains, and discharges from the body; but rarely about the person or clothing, as they are too irritant to be inhaled with impunity, and they destroy the color of fabrics. In very dilute solution they are employed with great benefit as local applications in—

Diphtheria, and other septic diseases,—to destroy fetor chiefly.

Gangrenous Ulcers and wounds, foul discharges, etc.,—as deodorizers.

Bites of serpents and insects,—a strong solution of Chlorin. Soda.

Throat Affections,—an excellent gargle is the mixture of Potassium Chlorate with the Tincture of the Chloride of Iron, in which the former is decomposed by the free HCl always present, and the resulting solution contains Chlorine, Euchlorine, Potassic and Ferric Chlorides,—perhaps the best and most innocuous mixture of antiseptics known.

Nitrate of Silver Poisoning,—Sodium Chloride as an antidote.

Migraine,—both Sodium and Ammonium Chlorides are efficient.

Intermittent Fever has been cured by Sodium Chloride, in 8 to 10-drachm doses, given during the apyrexia.

Bilious Diarrhœa,—Sodium Chloride, gr. x–ʒ j, thrice daily.

Ascarides,—Sodium Chloride, in solution by enema, two tablespoonsful of the salt to a pint of water,—will effectually destroy them.

EVACUANTS.

Remedies which promote some Evacuation from the body,—such as Emetics, (including Ipecacuanha), Cathartics, (including Bryonia and Baptisia), Anthelmintics, Diuretics, and Emmenagogues.

LOCAL EMETICS.

Cupri Sulphas, Sulphate of Copper,—gr. vj, in water, every 15 minutes until emesis occurs; gr. xij may be given at one time in narcotic poisoning. Is promptly efficient. (*See* page 90.)

Zinci Sulphas, Sulphate of Zinc,—gr. vj or viij, in water, every 15 minutes until emesis. Is less irritant than the copper salt.

Hydrargyri Subsulphas Flavus, Yellow Subsulphate of Mercury, Turpeth Mineral, gr. iij–v, in powder, with Sugar of Milk. The best emetic in croup, being tasteless. (*See* page 75 *et seq.*)

Alumen, Alum,—a teaspoonful in honey, every half hour. Is safe and efficient, but slow. (*See* page 94.)

Sinapis Alba, vel Nigra, White or Black Mustard,—as emetic, a teaspoonful or more, in water. Is stimulant to the heart and circulation, also a condiment and carminative in small doses. (*See* page 221.)

Physiological Action. *Vomiting* is an evacuant act which consists in compression of the stomach by the simultaneous spasmodic contraction of the diaphragm and abdominal muscles; and relaxation of its cardiac orifice by contraction of the radiating muscular fibres in the gastric wall. If both acts occur at the same time, the contents of the stomach are expelled and *vomiting* occurs; if, however, the two acts do not take place simultaneously, the contents of the stomach are retained, and the abortive efforts are called *retching*. These acts are controlled and regulated by a nerve-centre in the medulla oblongata, which is closely connected with the respiratory centre, the muscular movements of vomiting being merely modified respiratory movements. This vomiting centre is ordinarily excited in two ways,—(1) by the peripheral stimulation of afferent nerves going to it from other parts of the body,—(2), by impulses sent down to it from the brain. (Brunton).

Local Emetics act upon the pharynx, œsophagus, or stomach;—*General Emetics* act through the medium of the circulation wherever introduced. Some agents act both ways, *e.g.* Tartar Emetic; also Zinc and Copper Sulphates, but in the cases of the two latter, their action on the stomach preponderates so much over their general action, that they are classed with the local emetics.

The action of local emetics does not continue long,—does not extend beyond the act of producing emesis, ceasing after the emetic has been evacuated,—and is not accompanied by much general depression.

Therapeutics. Emetics are employed for several purposes, among which may be mentioned the following:—

(1). To cause the expulsion of foreign bodies from any part of the œsophageal tract, or from the air-passages.
(2). To remove or evacuate the contents of the stomach.
(3). To remove an obstruction from the gall-duct.

Contraindications for their use, are—aneurism, atheroma, hemorrhagic diathesis, hernia, prolapsus uteri, and tendency to abortion (when subject is pregnant).

They are especially indicated in—

Narcotic Poisoning,—the Copper Sulphate or the Zinc Sulphate, the latter being usually preferred.

Croup and *Diphtheria*,—to dislodge false membrane.

Indigestion,—to relieve the overloaded stomach.

SYSTEMIC EMETICS.

Apomorphina, Apomorphine,—an alkaloidal derivative from Morphine by the action of strong acids or zinc chloride. Emetic dose by stomach, gr. $\frac{1}{8}$–$\frac{1}{6}$, hypodermically, gr. $\frac{1}{16}$, in a fresh solution. Is very depressant to the heart, and has caused death by cardiac failure. Is the best emetic when swallowing is difficult, but is useless in narcotic poisoning after narcosis has blunted the vagus centre. Has convulsant action on animals, and some expectorant power. (See *ante*, page 145).

Apomorphinæ Hydrochloras. Dose, gr. $\frac{1}{20}$–$\frac{1}{12}$ hypodermically.

Antimonii et Potassii Tartras, Tartar Emetic. (See page 69, *ante*).

Is too slow and depressant to be used as an emetic. Dose, gr. $\frac{1}{16}$–$\frac{1}{4}$, as an expectorant, or a diaphoretic; gr. j–ij as an emetic.

IPECACUANHA,—Ipecac.

Source and Composition. Ipecac is the root of *Cephaëlis Ipecacuanha*, a Brazilian shrub of the nat. ord. Rubiaceæ. It contains a crystalline alkaloid *Emetine*, a glucoside *Ipecacuanhic Acid*, also gum, starch, etc., and a trace of a volatile oil. Dose, of the powdered root as an expectorant, gr. ss–gr. ij;—as an emetic, gr. xv–gr. xxx.

Preparations. The principal ones are—

Extractum Ipecacuanhæ Fluidum, Fluid Extr. of Ipecac. Dose, ♏j–v.
Vinum Ipecacuanhæ, Wine of Ipecac,—7 per cent. Dose, ♏j–ʒj.
Syrupus Ipecacuanhæ, Syrup of Ipecac,—5 per cent. Dose, ʒj–iv.
Pulvis Ipecacuanhæ et Opii, Dover's Powder,—has of Ipecac 10, Pulvis Opii 10, Sugar of Milk 80 parts, Dose, gr. ij–xv.
Tinctura Ipecacuanhæ et Opii, Liquid Dover's Powder,—has of Deod. Tinct. of Opium 10, Fl. Extr. of Ipecac 10, Alcohol 80. Dose, ♏ij–xv.
**Emetina*, Emetine,—a crystalline alkaloid, odorless, bitter, white, nearly insoluble in water, but with acids forming salts which are readily soluble. An energetic poison in large dosage. Dose, as an expectorant, gr. $\frac{1}{120}$–$\frac{1}{40}$; as an emetic, gr. $\frac{1}{8}$–$\frac{1}{4}$.

Physiological Action. Ipecac is nauseant, emetic, expectorant, cholagogue, diaphoretic, hemostatic, sternutatory and counter-irritant. Locally, applied to skin or mucous membrane, it acts as an irritant, and may cause pustulation. Inhaled as a powder, it excites violent sneezing and reflex mucous secretion; on some persons having an especially irritant action, so that the most infinitesimal quantity by inhalation will in them induce an asthmatic paroxysm. In the stomach it irritates the mucous membrane and the vagus terminations, and causes prompt emesis. Absorbed into the blood it excites the vomiting centre in the medulla, producing the same result. In medicinal doses it increases the mucous secretions in a marked degree, and is slightly diaphoretic. Small doses (gr. $1/8$–$1/4$) act as a stomachic tonic and stimulant to the gastric secretions. Emetic doses repeated result in tolerance on the part of the stomach, when catharsis is set up, the stools having a peculiar "grass-green" color, a bilious character, and looking as if they were fermented. By continuance of the drug the intestinal canal will also acquire tolerance,—the cathartic action ceasing.

Emetine causes death in animals by cardiac paralysis; the autopsies showing evidences of intense gastro-intestinal irritation, also hyperæmic lungs with patches of hepatization.

Antagonists, Antidotes, etc. The emetic action is antagonized by the *Narcotics* generally, also by Bismuth, Carbolic and Hydrocyanic Acids.

Incompatibles are salts of Lead and Mercury, Vegetable Acids and astringent infusions.

Therapeutics. As an emetic Ipecac is much used, being safe, non-depressant, and sure, though somewhat slow. It is also employed as an expectorant in bronchitis when the secretion is scanty, and as an antihemorrhagic and an antidysenteric. It is generally administered in—

Bilious Headache, acute indigestion, and similar conditions,—gr. iv of the powder in warm water, or a teaspoonful of the syrup, every ¼ hour until emesis occurs,—to empty the overloaded stomach.

Fevers, at their commencement,—an Ipecac-vomit is very serviceable in the eruptive, continued and malarial fevers.

Laryngismus Stridulus, Spasmodic croup, etc.,—the Syrup is a favorite domestic emetic, which generally cuts short an attack if given early, and freely.

Dysentery, of the tropics especially,—is best treated by Ipecac in large doses (gr. xx–xxx every 4 hours) pushed to tolerance.

Vomiting, especially when of nervous origin,—small doses (♏j) of the wine, frequently repeated, will relieve in many cases, perhaps through a sedative influence on the vagus.

Coughs at night, also in *Acute Catarrh* and *Bronchitis*,—it is a very efficient remedy;—also in *Hay Fever* and *Spasmodic Asthma*, in all of which slight nauseation must be produced before relief will be experienced. The wine, as a spray, is highly recommended in winter cough and bronchial asthma.

Jaundice from catarrh of the bile-ducts,—Ipecac to lessen the viscidity of the mucus stopping up the ducts.

Rheumatism, muscular or acute,—Dover's powder is useful.

CATHARTICS.

CATHARTICS are subdivided into Laxatives, Simple, Saline, Drastic, Hydragogue and Cholagogue Purgatives. (See *ante*, page 34).

LAXATIVES.

Sulphur. Sulphur Lotum, Washed Sulphur. (See page 71). Dose, ʒj–iij, as a laxative.

Manna,—the concrete exudation of *Fraxinus ornus*. Dose, ʒj–℥ij. Contains *Mannite*, a sugar; also a *Resin*, probably the laxative principle.

Tamarindus, Tamarind,—the preserved pulp of the fruit of *Tamarindus Indica*. Used in *Confectio Sennæ*. Dose, indefinite.

Magnesii Carbonas, Carbonate of Magnesium,—Dose, ʒj–℥j. A mild laxative and antacid, but if long used it may form intestinal concretions.

Mistura Magnesiæ et Asafœtidæ, Dewees' Carminative,—for flatulent colic and diarrhœa of infants,—Dose, gtt. xx–ʒj as per age. Has Mag. Carb. 5, Tinct. Asaf. 7, Tinct. Opii 1, Sugar 10, Water 77.

Oleum Ricini, Castor Oil—is a laxative in small doses, (ʒj), though classed with the simple purgatives. (See below). Also all the Simple Purgatives in minimum doses.

Fruits of various kinds,—particularly Figs, Prunes, Stewed Apples, Raspberries and Strawberries,—many of which act through the mechanical stimulation of intestinal peristalsis by their small, indigestible seeds.

SIMPLE PURGATIVES.

Senna,—the leaflets of *Cassia acutifolia* and *Cassia elongata*. Contains a glucoside, named *Cathartic Acid*, which is probably the active principle; also *Sennacrol*, *Sennapicrin*, bitter principles, *Catharto-mannite*, a sugar; and a peculiar colloid body.

Extractum Sennæ Fluidum, Dose, ℥ss. *Syrúpus Sennæ*, ʒj–℥j.

Confectio Sennæ, Tamar-Indien, Tropical Fruit-Laxative, ʒj–iv.

Infusum Sennæ Compositum, Black Draught, ℥j–iv. Contains in 100 parts, Senna 6, Manna 12, Magnesii Sulphas 12, Fennel 2.

Senna is a constituent also of the *Pulvis Glycyrrhizæ Compositus*, of which it forms 18 per cent., with Liquorice 16, Fennel 8, Sulphur 8, and Sugar 50 parts, all triturated together. Dose, ʒj–℥ss.

Rheum, Rhubarb,—the root of *Rheum officinale*. Contains *Phæoretin*, a purgative resin;—also *Chrysophanic*, *Rheo-tannic* and *Rheumic Acids*, and the glucoside *Chrysophan*.

Extractum Rhei, gr. x–xv. *Extr. Rhei Fl.*, ʒss–ij.
Pilulæ Rhei, i–iij. *Pilulæ Rhei Compositæ*, ij–iv.

Aloë, Aloes,—the inspissated juice of the leaves of *Aloë socotrina*. Contains *Soaloïn*, also a Resin and a Volatile Oil. *Aloin* is the principle common to all varieties of the plant, and official in the B. P.

Aloë Purificata, gr. j–v. *Pilulæ Aloës*, pills j–v.
Pilulæ Aloës et Asafœtidæ, ij–v. *Extr. Aloës Aquosum*, gr. ss–gr. vj.
Tinctura Aloës, ʒss–℥j. *Tinct. Aloës et Myrrhæ*, ʒss–ij.

Oleum Ricini, Castor Oil,—a fixed oil expressed from the seeds of *Ricinus communis*,—Dose ʒj–℥j. The purer it is the less purgative. Contains *Palmitic* and *Ricinoleic acids*. The seeds also contain a non-purgative alkaloid, *Ricinine;* and an acid, drastic principle. Castor Oil is a constituent of Linimentum Sinapis Compositum, and Collodion Flexile.

* **Cascara Sagrada,** Sacred Bark,—is the bark of the California buckthorn, *Rhamnus Purshiana*, a small tree of the nat. ord Rhamnaceæ. It contains several *Resinoids*, which are supposed to be derived from *Chrysophanic Acid;* also much tannin, and a volatile oil, etc.

* *Extractum Cascaræ Sagradæ*, (B. P.),—Dose gr. ij–x.

* *Extractum Cascaræ Sagradæ Fluidum*, (B. P.),—Dose, ʒ ss–ij.

Frangula, Buckthorn,—is the bark, collected at least one year before being used, of *Rhamnus Frangula*, or Alder buckthorn, a European shrub of the nat. ord. Rhamnaceæ. It contains a cathartic principle, named *Frangulin*, or *Rhamnoxanthin*, insoluble in water, and but sparingly so in alcohol or ether, and thought to be identical with Cathartic Acid, the active principle of Senna.

Extractum Frangulæ Fluidum,—Dose, ʒ ss–ij.

SALINE PURGATIVES.

Magnesium Salts. The chief ones are the following,—

Magnesii Sulphas, Epsom Salts,—Dose, ʒ j–℥ j. Is very soluble.

Magnesii Citras Granulatus,—Dose ℥ ss–j, drank effervescing.

Potassium Salts. The principal ones are—

Potassii et Sodii Tartras, Rochelle Salt,—Dose, gr. xx–℥ ss. (See page 65).

Pulvis Effervescens Compositus, Seidlitz Powder,—(See page 66.)

Potassii Tartras, Tartrate of Potassium,—Dose, ʒ ij–iv.—Very soluble.

Potassii Bitartras, Cream of Tartar,—Dose, ʒ ij–iv, sparingly soluble in water, insoluble in alcohol. Is diuretic, in doses of ʒ ss–j.

Potassii Sulphas, Sulphate of Potassium,—Dose, gr. xv–ʒ j.

Sodium Salts. Those generally employed are as follows:—

Sodii Sulphas, Glauber's Salt,—Dose, ʒ ij–℥ j. Soluble in water.

Sodii Phosphas, Phosphate of Sodium,—Dose, ʒ ij–℥ j, as a purgative; gr. xx–xl as an alterative. Has some pronounced cholagogue action, especially on children in 3 to 10-grain doses. Acts gently, and has little or no taste.

DRASTIC PURGATIVES.

Jalapa, Jalap,—the tuberous root of *Exogonium purga*. Contains *Convolvulin* or *Jalapin*, one of two Resins, and the most purgative; besides various secondary products.

Abstractum Jalapæ, Dose, gr. j–iij. *Resina Jalapæ*, Dose, gr. ij–v.

Pulvis Jalapæ Compositus, Dose, gr. x–ʒ j;—contains Pot. Bitartrate, 65 per cent.

Scammonium, Scammony,—a resinous exudation from the root of *Convolvulus Scammonia*. Contains a Resin, which consists chiefly of *Jalapin*, differing from the Convolvulin or Jalapin of Jalap, in that it is soluble in ether, while the latter is not.

Resina Scammonii, Resin of Scammony,—Dose, gr. v–x. Is a constituent of the Compound Extract of Colocynth. (See below).

Oleum Tiglii, Croton Oil,—a fixed oil expressed from the seeds of *Croton tiglium*. Contains several fatty and volatile acids, one of which is called *Tiglinic Acid*, another *Crotonic Acid*.

Oleum Tiglii, gtt. $\frac{1}{3}$–gtt. ij, in pill of bread-crumb.

Cambogia, Gamboge,—a gum-resin from *Garcinia Hanburii*, from Siam.

Pilulæ Catharticæ Compositæ, Compound Cathartic Pill. (See under COLOCYNTH, below).

Colocynthis, Colocynth,—the fruit of *Citrullus Colocynthis*, the "bitter cucumber," a vine of the nat. ord. Cucurbitaceæ, which also includes *Ecballium Elaterium*, *Cucurbita Pepo*, and *Bryonia alba*. (See below). Colocynth contains an active, purgative glucoside, *Colocynthin*;—also *Colocynthitine*, which is soluble in ether, insoluble in water, and not purgative.

Extractum Colocynthidis,—Dose gr. j–v. Not used alone.

Extractum Colocynthidis Compositum, Compound Extract of Colocynth,—has of the Extract 16, Aloes 50, Cardamom 6, Resin of Scammony 14, Soap 14, and Alcohol 10 parts. Dose, gr. v-x.

Pilulæ Catharticæ Compositæ, Compound Cathartic Pills,—each has of the preceding gr. j $\frac{3}{10}$, Abst. of Jalap gr. j, Calomel gr. j, and Gamboge gr. $\frac{1}{4}$. Dose, j–iij pills.

Elaterinum, Elaterin,—a neutral principle from *Elaterium*, a substance deposited by the juice of the fruit of *Ecballium Elaterium*, the "squirting cucumber," nat. ord. Cucurbitaceæ. (See above). Dose, gr. $\frac{1}{30}$–$\frac{1}{10}$, in pill or trituration.

Trituratio Elaterini, Trituration of Elaterin,—10 per cent., with Sugar of Milk. Dose, gr. ss–j. The corresponding preparation in the Brit. Phar. is the *Pulvis Elaterini Compositus*, which has 1 part of Elaterin to 39 of Sugar of Milk; its dose being gr. j–v.

CHOLAGOGUE PURGATIVES.

Podophyllum, May-apple,—the rhizome and rootlets of *Podophyllum peltatum*. Contains the alkaloid *Berberine*, and two Resins, both purgative. *Podophyllin* is an eclectic name for the Resina.

Abstractum Podophylli, gr. $\frac{1}{8}$–j.
Extractum Podophylli, gr. v–x.
Resina Podophylli, gr. $\frac{1}{4}$–j.
Extr. Podophylli Fl., ♏v–xxx.

Leptandra, Culver's Root,—the rhizome and rootlets of *Leptandra Virginica*. Contains a Resin, and a crystalline principle. The *Leptandrin* of the shops is an impure resin.

Extractum Leptandræ Fluidum,—Dose ♏xx–ʒj.

Iris, Blue Flag,—the rhizome and rootlets of *Iris versicolor*. The *Iridin* of the shops is an impure oleo-resin.

Extractum Iridis Fluidum,—Dose ♏xx–ʒj.

Extractum Iridis,—Dose gr. ij–v. **Iridin*,—Dose gr. j–iij.

Euonymus, Wahoo,—the bark of *Euonymus atropurpureus*. Contains a bitter principle, named *Euonymin*, also Resins, an Oil, etc.

Extractum Euonymi,—Dose gr. j–v.

Hydrargyri Chloridum Mite, Calomel,—Dose gr. j–gr. x. (*See* page 75).

Hydrargyrum cum Creta, Gray Powder,—Dose gr. ss–gr. iv. (*See* p. 76).

Massa Hydrargyri, Blue Mass, Blue Pill,—Dose, gr. ij–x. (See page 77).

Aloës, *Rhubarb*, *Jalap*, *Scammony*, *Sodium Sulphate* and *Phosphate*, and many other hepatic stimulants, may be classed with the cholagogue purgatives:—as also all cathartics which act upon the duodenum, and prevent the absorption of the once-secreted bile;—such being *Baptisin*, *Colocynth*, etc.

Actions of the various Cathartics. *The Laxatives* simply relax and unload the intestinal canal, without causing active purgation, or increase of the intestinal secretions. *Saline Purgatives* produce watery stools, by increasing secretion and stimulating peristalsis. *Drastic Purgatives* cause violent action of the bowels, in large doses setting up enteritis and symptoms of irritant poisoning. Those which excite a copious flow from the intestinal mucous membrane are called *Hydragogue Purgatives*, some of which belong to the drastic group (Elaterium, Gamboge), and some to the saline (Potassium Bitartrate). *Cholagogue Purgatives* are those which remove bile from the body, chiefly by causing increased peristalsis of the duodenum, and thus preventing the reabsorption of the bile therein. The *Mercurial Purgatives* are now believed not to affect the secretion of bile, but they markedly stimulate the excrementitious glands situated in the lower part of the ileum.

Therapeutics. Cathartics are indicated for the purposes of—*unloading the bowels* of fecal matter or offending materials,—*depletion* of the vascular system in many diseases,—*promotion of absorption* in general dropsy, ascites, etc.—*revulsion* in inflammation of the brain, etc.,—*elimination* of the products of the retrograde metamorphosis,—lowering of the *temperature* in fever,—lowering of the *blood-pressure*,—and *excitation* of the pelvic circulation. For the last purpose Aloë is the only agent used. *Castor Oil* is much used, and abused, especially in the puerperal state, where it is very apt to produce hemorrhoids. The leaves of the plant applied to the breasts, as a poultice, are said to promote the secretion of milk. *Croton Oil*, though a powerfully drastic agent, is one of the most manageable and easily administered purgatives, by reason of the smallness of the dose required. [The various agents, enumerated under this title, have other actions and uses besides that of catharsis, but the limitations of this volume prevent their discussion. Two, which seem to merit separate consideration, are Bryonia and Baptisia, which are described in the following pages.]

BRYONIA,—Bryony.

Source and Composition. The root of *Bryonia alba* and of *Bryonia dioica*, European perennial vines of the nat. ord. Cucurbitaceæ. (See above, under COLOCYNTHIS). Its active principle is the bitter glucoside *Bryonin*. Dose of the root, gr. v–x.

Preparations. Only one is official, viz.—

Tinctura Bryoniæ,—Bryonia-root 1, Alcohol 9. Dose, ♏x–ʒij.
**Bryonin*, as a drastic purgative, gr. $\frac{1}{6}$–$\frac{1}{3}$. Poisonous in dose of gr. iij–iv.

Physiological Actions. Bryonia is violently irritant to the mucous and serous membranes; taken internally it has caused fatal gastritis and enteritis; introduced into the pleura it has produced fatal pleurisy with fibrinous effusion. It is a drastic purgative, a powerful diuretic, and very depressant to the heart. It produces cerebral, hepatic and renal congestion, with bilious symptoms, (even severe jaundice,) and vesical tenesmus.

Therapeutics. Bryonia was formerly used as a hydragogue cathartic, but in that respect it is now superseded by Jalap. By many practitioners it is highly praised in the second stage of serous inflammations, to limit the extent of the effusion and to promote its absorption. For this, small repeated doses are required. In—

Pleuritis and Pericarditis,—it is useful, (after Aconite has reduced the pyrexia,) to check the effusion and aid its absorption.

Rheumatism,—for the painful and stiff joints, after their swelling has been reduced by other measures.

Headaches, of "bilious" type, with vomiting,—it is an efficient remedy.

Dropsies,—an infusion of Bryonia will remove the accumulated fluid, by its cathartic and diuretic action.

Epilepsy, Mania and Hysteria,—Bryonia is of ancient repute.

*BAPTISIA,—Wild Indigo.

Source and Composition. The root-bark of the indigenous plant *Baptisia tinctoria*, or Wild Indigo, a member of the nat. ord. Leguminosæ. It contains an alkaloid and a resin, neither of which have been examined critically. *Baptisin*, so-called, is an impure resinoid, obtained by precipitation from the alcoholic extract.

Preparations.

**Extractum Baptisiæ*, Extract of Baptisia,—Dose, gr. j–x.
**Extractum Baptisiæ Fluidum*, Fluid Extract of Baptisia,—Dose, ♏ij–xx.
**Tinctura Baptisiæ*, Tincture of Baptisia,—Dose, ♏v–xxx.
**Baptisinum*, Baptisin,—the resinoid. Dose, gr. j–v.

Physiological Action. Baptisia, in full doses, is an energetic emeto-cathartic, and may excite severe inflammation of the gastro-enteric mucous membrane. Its taste is acrid and bitter; and in small doses it acts as a cholagogue laxative. Having decided power as a hepatic stimulant, thus promoting the secretion of bile;—and also increasing, as it does, the peristaltic action of the small intestine, and the secretions of the intestinal glands, thereby preventing the reabsorption of bile, through the entero-hepatic circulation, by sweeping it onward,—Baptisia has all the qualities necessary for an efficient cholagogue. It has considerable power as an antiseptic, and also as an alterative vulnerary.

Therapeutics. The use of Baptisia in medicine is based chiefly on its cholagogue and alterative actions. It may be employed both locally and internally. In—

Gangrenous Ulcers and Sores, also in obstinate wounds and ulcers,—it is an excellent application, either in decoction or as a poultice.

Low Fevers form its chief field as an internal remedy,—especially in the first stage of typhoid, and in those continued fevers of no particular type, but usually considered mild cases of typhoid, or "*gastric fever*" by the laity. In these affections, drop doses of a fresh tincture hourly, have proven of signal benefit.

Feverish Colds of aged people, and in incipient febrile conditions, where the tongue is coated, and there is a sensation of sinking at the stomach, with entire anorexia,—Baptisia does good service,—cleaning the tongue and restoring the appetite.

Hectic Fever of phthisis,—it is reported to be of service in reducing the febrile movement.

Variola, *Epidemic Dysentery*, *Scarlet Fever*, and *Typhus*, are diseases in which Baptisia has been employed with benefit.

ANTHELMINTICS.

Santonica, Levant Wormseed,—the unexpanded flower-heads of *Artemisia maritima*. Contains *Santonin*, a crystalline neutral principle.

Santoninum, Santonin—Dose, gr. ¼–v, as per age, with Calomel.

Trochisci Sodii Santoninatis. Each troche contains one grain of the Santoninate of Sodium. Dose, ij–x, as per age.

Chenopodium, American Wormseed,—the fruit of *Chen. ambrosioides*.

Oleum Chenopodii, gtt. v–xv, thrice daily, then a cathartic.

Spigelia, Pinkroot,—the root of *Spigelia marilandica*. Contains a Bitter Principle, a Volatile Oil, Tannic and Gallic Acids.

Extractum Spigeliæ Fluidum,—Dose, ♏x–ʒij, as per age.

Aspidium, Filix-mas, Male Fern,—the rhizome of *Aspidium filix-mas* and *Aspidium marginale*. Contains *Filicic Acid*, a green, fatty Oil, a Volatile Oil, etc.

Oleoresina Aspidii,—Dose, ♏v–ʒj. ℥iss caused death.

Granatum, Pomegranate,—the bark of the root of *Punica granatum*. Contains *Punico-tannic Acid* in large quantity, and an active liquid alkaloid, *Pelletierine*.

**Decoctum Granati* (℥ij ad Oj), ℥ij every hour, up to Oj.

**Pelletierinæ Tannas*,—Dose, gr. ss–j, followed by a cathartic.

Brayera, Kousso,—the female inflorescence of *B. anthelmintica*. Contains *Koussin*, a principle, which by itself seems inert.

Extractum Brayeræ Fluidum,—Dose, ℥ss in water.

Infusum Brayeræ,—strength, 6 per cent. Dose, ℥iv–viij or more.

Terebinthina, Turpentine (*see* page 214),—Dose, ℥ss–℥ij of the Oil. It should be combined with a purgative, as Castor Oil.

Kamala, Rottlera,—the glands and hairs from the capsules of *Mallotus Philippinensis*. Dose, ʒj–ʒiij.

Pepo, Pumpkin seed,—the seeds of *Cucurbita pepo*. Dose, ℥ij in emulsion, or three half-℥ doses of the Expressed Oil, followed by a cathartic.

Quassia, Aloe, also **Carbolic Acid**, gr. xx ad Oj aquæ,—as injections against the Oxyurus Vermicularis (thread-worm).

The Anthelmintics used against the *Ascaris Lumbricoides* (round-worm) are Santonin, Chenopodium, and Spigelia;—those against the *Oxyurus Vermicularis* (thread-worm) are the same, aided by injections of weak decoctions of Quassia or Alöe, or of Carbolic Acid, gr. xx ad Oj aquæ;—those against the Tæniæ (tape-worms) are Aspidium, Granatum, Brayera, Kamala, Pepo, and Turpentine. Chloroform is sometimes used as a tænia-fuge, and with very great success, in ʒj doses in ℥j of mucilage, for an adult, followed by ℥j of Castor Oil.

DIURETICS.

Refrigerant Diuretics.

Potassium Salts, (See page 64),—especially the Acetate, Bitartrate, Carbonate, Citrate, Chlorate and Nitrate. They should be largely diluted with water, that fluid of itself having very considerable diuretic power.

Potassii Acetas, Acetate of Potassium,—Dose, gr. x–xxx.

Hydragogue Diuretics.

Spiritus Ætheris Nitrosi, Spirit of Nitrous Ether, Sweet Spirit of Nitre,—(See page 136);—is diuretic in a dose of ʒ ij–iv, but is generally employed as an adjuvant to more powerful agents of the same class.

Mistura Glycyrrhizæ Composita,—has 3 per cent. of it.

Digitalis, Foxglove, (See page 102),—as a diuretic, gr. iij of the powdered drug daily, in divided doses, increased by a grain daily. The infusion or tincture may be used in corresponding doses. A poultice of ℥ j of the fresh leaves, over the abdomen, for eight hours, will also be sufficient.

Infusum Digitalis, Infusion of Digitalis,—Dose, ℥ ss–j, twice daily.

Scilla, Squill, (See page 111),—Dose of the powdered drug, gr. j–iij.

Tinctura Scillæ, Dose, ♏v–xxx. *Acetum Scillæ*, Dose, ♏x–ʒ j.

Scoparius, Broom, (See page 109),—also its alkaloid *Sparteine.*

**Decoctum Scoparii*, (℥ j to the pint),—Dose, ℥ j every 3 hours.

**Sparteinæ Sulphas*, Sulphate of Sparteine,—Dose, as a diuretic, gr. j–iij, thrice daily; for cardiac action, gr. $\frac{1}{16}$–$\frac{1}{4}$.

***Strophanthus,** (See page 105),—Dose, of the tincture (1 in 20) ♏v–x, or ♏ss–ij, frequently repeated; of *Strophanthin*, gr. $\frac{1}{120}$–$\frac{1}{60}$.

Cimicifuga, (See page 107),—Dose, of the tincture, ♏xv–ʒ j.

***Convallaria,** (See page 108),—Dose of the infusion, ℥ ss–ij.

***Cocaine,** (See page 124),—Dose of the Hydrochlorate, gr. ⅛–¼.

Caffeine, (See page 126),—the Citrate in doses of gr. v.

Hydrargyrum, (See page 76). The Mild Chloride a very efficient diuretic, especially in cardiac affections; dose, gr. ss–j. The Hydrarg. cum creta, with Pulv. Digitalis and Pulv. Scillæ, gr. j of each, in pill thrice daily, a classical and efficient diuretic.

Stimulant Diuretics.

Apócynum, Canadian Hemp,—the root of *Apócynum cannábinum*. Is a valuable diuretic in doses of gr. xv; in larger doses it is a hydragogue cathartic and an emetic. It has been used with benefit in anasarca and ascites. The active principle, *Apocynin*, is a good expectorant in ¼ to ½ grain doses.

Buchu, the leaves of *Barosma betulina* and other species of Barosma. Contains a Volatile Oil, and perhaps *Barosmin*, a bitter principle.

Extractum Buchu Fluidum, ♏x–ʒj. * *Infusum Buchu*, ℥ss–ij.

Capsicum, Cayenne Pepper,—the fruit of *Capsicum fastigiatum*. Contains *Capsicin*, a peculiar liquid principle; also a Volatile Alkaloid.

Oleoresina Capsici, ♏j–v. *Tinctura Capsici*, ♏x–ʒj.
Extractum Capsici Fl., ♏v–ʒss. *Emplastrum Capsici.*

Chimaphila, Pipsissewa,—the leaves of *Chimaphila umbellata*. Contain *Chimaphilin*, a crystalline principle, also *Arbutin*, Tannin, etc.

Extractum Chimaphilæ Fluidum,—Dose, ʒss–ʒij.

Copaiba, Balsam of Copaiba,—the oleo-resin of various species of *Copaifera*. Contains a Volatile Oil and a Resin named *Copaibic Acid*. Differs from the true balsams in that it contains *no Cinnamic Acid*.

Massa Copaibæ, Dose, gr. x–ʒj. *Oleum Copaibæ*, Dose, ♏v–ʒss.

Cubeba, Cubeb,—the unripe fruit of *Cubeba officinalis*. Contains *Cubebin*, a neutral principle, a Volatile Oil which may be separated into *Cubebene*, a camphor, and *Cubeben;* also a Resin which contains *Cubebic Acid*.

Oleoresina Cubebæ, ♏v–xxx. *Oleum Cubebæ*, ♏v–xx.
Tinctura Cubebæ, ʒss–ij. *Trochisci Cubebæ*, j–iij.
Extractum Cubebæ Fluidum, ♏v–xxx.

* **Damiana**, *Turnera aphrodisiaca*,—is the popular aphrodisiac now with the charlatans who advertise "manhood restorers." It is probably a stimulant diuretic, a bitter tonic, and, in sufficient doses, a purgative. Reports vary much as to its aphrodisiac powers. Dose, of fluid extract, ʒj–ij, up to ℥j daily. The leaves of the plant are used medicinally.

* **Gurjun Balsam**, Wood Oil,—is an oleo-resin obtained from incisions in trees of the genus *Dipterocarpus*. Its properties are similar to those of Copaiba, but it is less diuretic and less disagreeable. It has been well used in leprosy. Dose, ♏x–ʒij in emulsion or capsules.

* **Hydrangea**, *Hydrangea Arborescens*,—the root of this plant has long been used by the Cherokee Indians in calculous affections, and is of decided utility in these disorders, promoting the removal of gravel, relieving pain, etc. Dose, ʒss–ij, of fluid extract; of decoction, ℥j–ij.

Juniperus, Juniper,—the fruit of *Juniperus communis*. Contains *Juniperin*, a non-crystalline principle, also a Volatile Oil, etc.

Oleum Juniperi, ♏v–xx. *Spiritus Juniperi*, Dose ʒj–℥j.
Spiritus Juniperi Compositus, Gin, Dose ℥ss–℥j.
* *Oleum Cadini*, Oil of Cade, Empyreumatic Oil of Juniper,—locally.

***Kava-Kava**, root of *Piper methysticum*,—is intoxicant, diuretic and motor-depressant. A moderate dose is tonic and stimulant. It is highly recommended in gout, gonorrhœa, chronic gleet and obstinate cystitis. Dose, of root or fluid extract, ʒ ss–j.

* **Manaca**, *Franciscea uniflora*,—is advertised as a purgative, diuretic, emmenagogue and anti-syphilitic, but especially as a remedy for acute and chronic rheumatism. Dose of fluid extract, ♏v–ʒ j, several times a day.

Matico, the leaves of *Artanthe elongata*. Contain a Volatile Oil and a Resin, also *Artanthic Acid*.
Extractum Matico Fluidum, ʒ ss–ij. *Tinctura Matico*, ℥ ss–ij.

Pareira, Pareira Brava,—the root of *Chondodendron tomentosum*. Contains *Buxine*, an alkaloidal principle, also called *Cissampeline*.
Extractum Pareiræ Fluidum,—Dose ʒ ss–ʒ j.

Piper, Black Pepper, the unripe fruit of *Piper nigrum*. Contains *Piperine*, a feeble alkaloid (official), also a Resin and an Essential Oil.
Oleoresina Piperis, ♏¼–j. *Piperina*, Piperine,—Dose, gr. j–x.

* **Stigmata Maydis**, Corn Silk,—is diuretic, demulcent and antiseptic, and is highly recommended in cystitis, as a mild diuretic in cardiac and renal affections, and as a corrective of nocturnal incontinence of urine. Dose, of the fluid extract, ʒ j–ij.

Taraxacum, Dandelion,—the root of *Taraxacum Dens-leonis*. Contains two principles,—*Taraxacin*, bitter, amorphous; and *Taraxacerin*, crystalline. The French call it "Pissenlit."
Extractum Taraxaci, gr. v–xxx. *Extr. Taraxaci Fl.*, ʒ j–℥ j.

Uva Ursi, Bear-berry,—the leaves of *Arctostaphylos Uva-ursi*. Contain Tannic and Gallic acids, and three principles—*Arbutin*, neutral, bitter, crystalline; *Ericolin*, bitter, amorphous; and *Ursone*, neutral, tasteless, and crystalline. Dose of the powdered leaves, gr. x–ʒ j.
Extractum Uvæ Ursi Fluidum,—Dose, ♏x–ʒ j.

Physiological Actions of Diuretics. *The Refrigerant Diuretics* modify rather than increase the urine, and exercise a sedative action upon the heart and circulation. Used to excess they depress the heart and impoverish the blood. *Potassium Chlorate* is a decided renal irritant, and should never be used as a diuretic. *Hydragogue Diuretics* increase the water of the urine largely, and in general act by raising arterial pressure, either—(a) throughout the body, or (b) locally in the kidneys. This they accomplish in various ways, direct and indirect,—increasing the action of the heart,—contracting the efferent vessels so as to raise the pressure in the glomeruli,—dilating the afferent vessels, etc. The *Stimulant Diuretics* are largely eliminated by the kidneys, and act upon the entire genito-urinary mucous membrane by local irritation, which in excess causes inflammation, and symptoms of a violent character, as strangury, bloody urine, etc. All the members of this group should be used with great caution.

Therapeutics of Diuretics. These agents are employed in medicine for certain definite purposes, viz:—(1), to remove fluid from the tissues and cavities of the body in cases of dropsy;—(2), to promote the elimination of waste-products and other poisons from the blood;—(3), to maintain the action of the kidneys;—and (4), to dilute the urine, and to alter morbid conditions of that excretion. For the last-named purpose, the best agent is Distilled Water, acidulated with CO_2. For use in—

Dropsies from Cardiac Disease,—the most efficient diuretics are Digitalis and its congeners, also Caffeine, Squill, etc., which act on the general vascular system. Their action is always aided by a little Massa Hydrargyri.

Dropsy from Renal Disease,—Broom, Juniper and Nitrous Ether, are the most reliable diuretics.

Dropsy from Cirrhosis of the Liver,—Copaiba is the best of the diuretics, when the kidneys are healthy.

Elimination of Waste-products from the blood,—Potassium salts, especially the Nitrate and Bitartrate,—also Juniper, Caffeine, etc.

As Adjuvants to Diuretics,—where pressure on the uriniferous tubules, or venous congestion, prevent their action,—paracentesis abdominis, purgation, cupping over the loins, and even venesection, are often necessary to start the action.

TURPENTINE, PITCH, TAR.

A Turpentine is an oleo-resinous exudation, liquid or concrete,—consisting of a *Resin* combined with a particular Oil, named *Oil of Turpentine*, ($C_{10}H_{16}$),—and procured from various species of the nat. ord. Coniferæ (cone-bearers). Of the many turpentines two only are official, viz:—

Terebinthina, Turpentine,—a concrete oleo-resin obtained from *Pinus australis*, the "yellow pine," and from other species of Pinus, nat. ord. Coniferæ. Tough, yellow masses, of terebinthinate odor and taste. Dose, as a stimulant, antispasmodic or diuretic, gr. v–xxx;—as an anthelmintic, ℥ij–iv.

Terebinthina Canadensis, Canada Turpentine, Balsam of Fir,—is a liquid oleoresin, obtained from *Abies balsamea*, the "silver fir" or "balm of Gilead," nat. ord. Coniferæ. A viscid, yellowish liquid, on exposure drying into a transparent mass, completely soluble in ether, chloroform or benzol. Dose, gr. x–xxx.

Pix, Pitch,—is a resinous exudation from the stem of certain trees of the genera *Pinus* (Pine) and *Abies* (Fir and Spruce);—and may also be obtained by the evaporation of wood-tar. [See Pix Liquida below]. The three following varieties are official, viz:—

Pix Burgundica, Burgundy Pitch,—the prepared, resinous exudation of *Abies excelsa*, Norway spruce, nat. ord. Coniferæ. Hard, brittle, opaque masses, very fusible, readily soluble in glacial acetic acid. Used for plasters. Is composed of an amorphous *Resin*, mixed with *Oil of Turpentine*, and other isomeric oils, and *Abietic Acid*.

Pix Canadensis, Canada or Hemlock Pitch,—the prepared, resinous exudation of *Abies canadensis*, the hemlock spruce of the U. S. and Canada, nat. ord. Coniferæ. It is somewhat softer than the preceding. [For *Extract of Pinus Canadensis*, see page 87.]

Pix Liquida, Tar,—is an empyreumatic oleoresin, (a "bituminous liquid," B. P.), obtained by the destructive distillation of the wood of *Pinus palustris*, and of other species of Pinus, (nat. ord. Coniferæ). A thick, viscid, semi-fluid, of brownish-black color, acid reaction, slightly soluble in water, soluble in oils, alcohol, and in solution of potassa or soda. It consists of *Pyroligneous Acid*, methyl alcohol, acetic acid, *Creasote*, toluene, xylene, and other hydrocarbons; also oily bodies, especially the *Oil of Tar*;—and *Pyrocatechin*, a crystalline principle, which gives it its granular appearance. Dose, gr. x, several times daily, up to ʒij in the 24 hours.

Preparations of Turpentine, number 3, as follows:—

Oleum Terebinthinæ, Oil of Turpentine, Spirits of Turpentine,—is a volatile oil distilled from Turpentine, any variety furnishing it. Dose, as a stimulant or diuretic, ♏v–xv, in emulsion, 3 to 6 times daily;—as a cathartic or anthelmintic ℥ss or more, combined with other cathartics. A little glycerin and oil of gaultheria will disguise the taste.

A thin, colorless liquid, of characteristic odor and taste, having the sp. gr. 0.855 to 0.870, soluble in 6 of alcohol, mixes with other volatile and fixed oils, and dissolves resins, wax, sulphur, phosphorus and iodine. Bromine and powdered Iodine act violently on it, and when brought into contact with a mixture of Nitric and Sulphuric Acids it takes fire. It is isomeric with a number of volatile oils, has the formula $C_{10}H_{16}$—but constantly absorbs oxygen from the air when exposed, becoming thicker and less active, from formation of resin. It is a mixture of several hydrocarbons, each having the same formula as itself, viz:—$C_{10}H_{16}$.

Linimentum Terebinthinæ, Turpentine Liniment,—has 35 parts of the oil with 65 of Resin Cerate.

Linimentum Cantharidis, contains the oil in the proportion of 85 per cent., the other 15 being Cantharides; making a very powerful and unmanageable application unless closely watched.

Preparations of Tar and Pitch.

Oleum Picis Liquidæ, Oil of Tar,—a volatile oil distilled from tar, and containing a great variety of compounds, including hydrocarbons, phenols, paraffin, etc., among the phenols being Creasote and Carbolic Acid. Is used locally and as an atomized inhalation.

Syrupus Picis Liquidæ, Syrup of Tar,—6 per cent. Dose, ʒj–iv. Is merely a sweetened tar-water.

Unguentum Picis Liquidæ, Tar Ointment,—has equal parts of Tar and Suet.

Emplastrum Picis Burgundicæ. *Emplastrum Picis Canadensis*.
Emplastrum Picis cum Cantharide,—Warming Plaster.

Derivatives of Turpentine.

Resina, Resin, Colophony,—is the residue left after distilling off the volatile oil from turpentine; the portion of turpentine which is fixed by oxidation; consisting in greater part of *Abietic anhydride*, ($C_{44}H_{62}O_4$).

Ceratum Resinæ, Resin Cerate, Basilicon Ointment.

Emplastrum Resinæ, Resin Plaster, Adhesive Plaster.

***Terebene**, $C_{10}H_{16}$—is a hydrocarbon obtained by the oxidation of oil of turpentine by means of sulphuric acid. A colorless liquid, of hot taste, soluble in alcohol. Dose, ♏v–xx on sugar, or suspended in ℥ss of water by the aid of gr. xx of light carbonate of magnesium.

***Terebinthene**, $C_{10}H_{16}$—another isomeric hydrocarbon, obtained by distilling oil of turpentine with an alkali. This by hydration, is converted into *Terpine*, commonly called "*Hydrate of Terpine*," instead of *Hydrate of Terebinthene*, a solid, crystalline body, soluble in glycerin. Acting on this by an acid, we get an oily body, named *Terpinol*, the dose of which is gr. ij–v, while that of Terpine is gr. v–x. None of these bodies are soluble in water, but all are in alcohol.

***Sanitas**,—is a disinfecting solution obtained by the action of water upon oxidised turpentine, its active principle being *Peroxide of Hydrogen*. It is not poisonous, and does not stain the linen,—two qualities which strongly recommend it.

Analogues of Turpentine.

***Oleum Pini Sylvestris**, Oil of Scotch Fir, (B. P.),—a colorless liquid obtained by distilling the fresh leaves of *Pinus sylvestris*, nat. ord. Coniferæ. Used externally, and by inhalation.

***Chian Turpentine**,—from the *Pistaceæ Terebinthus*, a small larch, growing in Chio and Cyprus. Dose, gr. iij–v.

***Venice Turpentine**,—from the *Larix Europæa*, or European larch, procured as a viscid liquid in Switzerland. Is not the "Venice Turpentine" of commerce, which usually consists of resin dissolved in oil of turpentine.

***Thus Americanum**, Common Frankincense, (B. P.),—the concrete turpentine which is scraped off the trunks of *Pinus australis* and *Pinus Tæda*, Southern States of N. America. An ingredient of the Emplastrum Picis of the B. P.

Oleum Succini, Oil of Amber,—a volatile oil obtained by the destructive distillation of Amber (Succinum), which is a fossil resin, occurring in alluvial deposits in Bohemia, etc., and thought to be the exudation of *Pinites succinifer*, an extinct coniferous tree. Dose, gtt. v–x.

***Laricis Cortex**, Larch Bark, (B. P.),—the bark, deprived of its outer layer, of *Pinus Larix*, the common larch.

**Tinctura Laricis*, Tincture of Larch, (B. P.). Dose, ♏x–xxx.

Thuja, Arbor Vitæ,—the fresh tops of *Thuja occidentalis*, or Arbor Vitæ, a tree of the nat. ord. Coniferæ. Contains a volatile oil, which is given in doses of ♏j–v. A saturated tincture may be used in drachm-doses.

Juniperus, Juniper,—the fruit of *Juniperus communis*, a shrub of the nat. ord. Coniferæ.

Oleum Juniperi, ♏v–xx. *Spiritus Juniperi*,—ʒj–℥j.

Spiritus Juniperi Compositus, ℥ss–j; about equals good Gin.

**Oleum Cadini*, Oil of Cade,—a tar obtained by the destructive distillation of Juniper wood, but of uncertain purity.

Sabina, Savine,—the tops of *Juniperus Sabina*, a shrub of the nat. ord. Coniferæ, resembling Red Cedar (*Juniperus virginiana*), but of smaller size and having larger fruit. Dose, gr. v–x.

Extractum Sabinæ Fluidum,—Dose, ♏v–xv.

Ceratum Sabinæ, Savine Cerate,—10 per cent.

Oleum Sabinæ, Oil of Savine,—$C_{10}H_{16}$,—isomeric with oil of turpentine. Dose, ♏j–v.

Physiological Action. The agents enumerated in the foregoing list belong to the nat. ord. Coniferæ, (cone-bearing), and resemble each other very closely in their general actions. *The Turpentines* are all diuretic, stimulant, antispasmodic, rubefacient, hemostatic and anthelmintic; in large doses irritant, producing gastro-enteritis and ulceration of the intestinal mucous membrane; and in toxic dose they are paralyzant to the nerve-centers in the cerebrum, cord and medulla. Externally applied they are rubefacient, and highly antiseptic. Their virtues are wholly due to their volatile oil, the *Oil of Turpentine*, which is extremely active. Its vapor inhaled causes nasal and bronchial irritation, headache, and perhaps bloody urine and strangury, sneezing, a tight sensation about the eyes and dyspnœa. In small doses internally, it stimulates the vaso-motor centres, causing a rise of arterial tension;—but larger doses paralyze the same and lower the blood-pressure accordingly; affecting the nerve-centres in the cerebrum, spinal cord and medulla, in the order stated, causing diminution of voluntary movement, then lowered reflex action, and lastly slowed respiration. It is excreted by the various channels of elimination, especially by the kidneys and the lungs, which are stimulated to increased action by small doses; but after large ones the kidneys suffer particularly, the urine being suppressed, pain in the lumbar region, burning in the urethra, hematuria and strangury.

Tar resembles the turpentines in its action, and as it contains both Creasote and Carbolic Acid, it has some qualities which are referable thereto. *Pitch* is a cutaneous stimulant. *Thuja* and *Savine* are irritant and may produce abortion, their oils being frequently used for that purpose. Savine is supposed to congest the pelvic viscera in women. *Juniper* is a stimulant diuretic of considerable activity in disease, but does not seem to increase the flow of urine in health. Its oil acts similarly to turpentine, but is more efficient upon the kidneys.

Therapeutics. The external uses of these agents will be considered under the title "RUBEFACIENTS" further on. Internally, they have many applications; but, on account of their great activity as internal remedies, they are not very manageable, and hence are not popular medicines. In—

Hemorrhages from the mucous membranes, as that of the intestines in typhoid fever,—Oil of Turpentine is a very efficient hemostatic, in doses of ♏x–ʒj every hour or two, and the action carefully watched.

Phosphorus Poisoning,—the oldest Oil of Turpentine, (containing ozone), is an efficient antidote, preventing the formation of phosphoric acid, and converting the phosphorus into an insoluble substance resembling spermaceti. The new oil is useless.

Hysterical Affections,—Turpentine is an efficient antispasmodic, especially when used in combination with Ether (1 part to 3).

Tape-worm,—Oil of Turpentine is an efficient tæniafuge, if given in large doses (℥j–ij), with Castor Oil to insure its rapid passage through the intestinal canal, in order that it may not be absorbed.

Septic Fevers, as puerperal, erysipelas, etc., also in yellow fever, and pneumonia,—Oil of Turpentine is a valuable stimulant to the cardiac and vaso-motor centres.

Pulmonary Affections, such as bronchitis, acute and chronic; laryngitis, emphysema, phthisis with tendency to hemorrhage, etc.,—Turpentine, Terpine, Terebene, and Tar, are very useful agents, being employed by inhalation as well as internally, as stimulating expectorants and antiseptics.

Dropsy,—Juniper as a diuretic, cautiously when kidneys are diseased, and generally combined with other diuretics.

Amenorrhœa,—Thuja and Savine are used as emmenagogues, especially the latter agent, which is by some authorities considered to be the most powerful and at the same time the safest emmenagogue in the whole materia medica. (Phillips).

Papillomata in general are specifically controlled by Thuja, especially warts having a narrow base and a pendulous body; a strong tincture being applied locally, and used internally, in five-drop doses twice daily, at the same time.

EMMENAGOGUES.

Aloe, Aloës (See page 204),—is a purgative emmenagogue.

Ferrum, Iron (See page 53 *et seq.*),—is used as a tonic emmenagogue.

Cantharis, Cantharides, Spanish Flies,—the insect *Cantharis vesicatoria.* (See under next title, RUBEFACIENTS, etc.)

Sabina, Savine,—the tops of *Juniperus Sabina.* (See page 217.)
Oleum Sabinæ, Oil of Savine,—♏j–v.

Ruta, Rue,—leaves of *Ruta graveolens.* *Oleum Rutæ*, ♏j–v.

***Polygonum Hydropiperoides**, Water-pepper. *Fluid Extr.*, ♏x–ʒj.

***Petroselinum**, Parsley,—contains a liquid principle, named *Apiol*, which is used in France as a remedy for intermittents and the amenorrhœa of anæmia, in one dose of gr. xv. As sold here it is generally inert as an emmenagogue, but very active as an article of commerce.

Thuja,—the tops of *Thuja occidentalis*,—(See *ante*, page 217),—Dose, ♏j–v of the Oil, thrice daily.

Caulophyllum, Blue Cohosh,—is the rhizome and rootlets of *Caulophyllum thalictroides*, an indigenous plant, known to the Indians as "squaw-root." It is said to produce intermittent contractions of the gravid uterus, and to have diuretic, emmenagogue and anti-spasmodic powers. It is highly recommended in rheumatism of the hands and fingers, spasmodic dysmenorrhœa, and pain about the uterine region. Dose, gr. v–xx. *Caulophyllin* is an impure resin.

Pulsatilla,—the herb of *Anemone pulsatilla*, etc.,—in 5-drop doses of a green tincture, (1 in 2) made as per directions for Tinct. Herb. Recent. (U. S. P.) See *ante*, page 163.

Viburnum, the bark of *V. Prunifolium*, Sloe or Black Haw,—is said to be a sedative and tonic to the uterine and ovarian nerve-centres. It is used as an anti-abortive, and in uterine congestion, ovarian irritation, irregular menstruation with dysmenorrhœa and menorrhagia. The fluid extract is official, and may be given in doses of ♏xx–ʒj, with aromatics, nervous sedatives, Cannabis Indica or Morphine. *Viburnum Opulus* is highly valued by those who have used it as a remedy for uterine and other abdominal pains. Its preparations are used in the same doses as the others. Though not generally classed among emmenagogues, being rather uterine sedatives, these agents often promote the menstrual flow by relieving pain and irritation of the ovaries at the period.

Tanacetum, Tansy,—the leaves and tops of *Tanacetum vulgare*.
Oleum Tanaceti, Oil of Tansy,—Dose, ♏j–iij.
**Infusi Tanaceti*, Tansy Tea,—℥j ad Oj. Dose, ℥j–ij.

Hedeoma, Pennyroyal,—leaves and tops of *Hedeoma pulegioides*.
Oleum Hedeomæ, Oil of Pennyroyal,—Dose, ♏j–v.

Origanum, Wild Marjoram,—the plant *Origanum vulgare*.
* *Oleum Origani*, Oil of Origanum,—Dose, ♏j–v. Was formerly official, but now out of fashion. Origanum is an ingredient of Vinum Aromaticum.

Manganum, Manganese (see page 54)—the *Black Oxide* (Binoxide), in doses of gr. ij, also the *Permanganate of Potassium*, in gr. j thrice daily.

Mercury,—the Biniodide, in doses of gr. ¼ in pill twice daily, or gr. ⅛ four times a day;—is certain and safe. (*Lancet*, Jan. 29, 1887).

***Acidum Oxalicum**, Oxalic Acid,—in doses of gr. ss hourly, in ʒj of water and syrup. (*Gazette Hebdomadaire*, 1886, No. 20).

* **Indigo**,—in doses of ʒj to ʒiv of the powder thrice daily,—which is liable to cause great nausea by its bulk, unless mixed with a little subnitrate of bismuth, and followed by a little whiskey. A concentrated extract may be given in doses of one-fifth the amount of the crude drug, in capsules with Extract of Gentian and Subnitrate of Bismuth.

Quinine, has considerable emmenagogue power, by direct action as a stimulant upon the uterus itself. Dose, gr. xx–xxx, as ecbolic; smaller doses, (gr. v), frequently repeated, as an emmenagogue.

Acidum Boricum, Boric or Boracic Acid,—also the Borate of Sodium, (Borax), the latter in doses of ten grains thrice daily.

Strychnina, Strychnine,—as a spinal stimulant, and equalizer of the circulation. (See page 96).

Purgatives,—among which *Aloës* is the most efficient, determining the blood to the pelvic viscera.

* **Viscum Flavescens**, the American *mistletoe*, growing on oaks, elms, etc.—in 30–grain doses, given in decoction.

Sinapis, Mustard, (See under next title),—as poultices, hot baths, or hot stupes, to pelvic region, and thighs.

Baths,—Hot foot, thigh and hip-baths at time of the expected period, in connection with medicinal treatment.

Actions and Uses of Emmenagogues. As explained on page 40, agents which promote menstruation may be arranged in two groups, according as they act by *Direct* stimulation of the uterine and ovarian apparatus,—or by *Indirect* means, as the correction of anæmia, of disturbed pelvic circulation, etc. The latter group is the one which should receive preference in the treatment of amenorrhœa, with occasional aid from the direct agents, which work by irritation, and must, therefore, be employed with great caution. The *Essential Oils* of Tansy, Pennyroyal, Rue, Thuja, Savine, etc., are much employed by the laity, for emmenagogue and abortifacient purposes; and with great danger, for they can only set up uterine contractions by reflex action from the irritation they produce in the gastro-intestinal tract. *Sabina* is believed to have more specific action on the uterus than the other agents named with it. It is supposed to congest the pelvic viscera in women, and is held by some authorities to be the most powerful, and at the same time the safest emmenagogue in the materia medica (Phillips). The *Black Oxide of Manganese* has been recently announced as an emmenagogue, as also have the *Permanganate of Potassium*, *Indigo*, the *Biniodide of Mercury*, and *Oxalic Acid*, each one being highly praised by its advocates.

TOPICAL AGENTS.

RUBEFACIENTS AND EPISPASTICS.

Sinapis, Mustard,—the seeds of *Sinapis alba* and *Sinapis nigra*.

Oleum Sinapis Volatile, ♏ ⅛–¼. *Linimentum Sinapis Compositum.* *Charta Sinapis*, Mustard paper.	All made from Black Mustard.

Composition of the Mustards.

SINAPIS ALBA contains—	*Sinalbin.* *Myrosin*, a ferment.	*Sulpho-cyanate of Acrinyl* is the rubefacient principle,—produced by reaction between these two in the presence of water.
	Sinapine, an alkaloid. A bland, fixed *Oil.* *Erucic or Brassic Acid.*	

SINAPIS NIGRA contains—
- *Sinigrin* (Pot. Myronate). } *Allyl Sulpho-cyanide*, the Volatile Oil of Mustard.
- *Myrosin*, a ferment. }
- *Sinapine*, an alkaloid.
- A bland, fixed *Oil*.
- *Erucic or Brassic Acid.*

Pix Burgundica, Burgundy Pitch,— } See *ante*, page 215.
Pix Canadensis, Hemlock Pitch,— }

Emplastrum Picis Burgundicæ, Burgundy Pitch Plaster.
Emplastrum Picis Canadensis, Canadian Pitch Plaster.
Emplastrum Picis cum Cantharide, Pitch Plaster with Cantharides.

Pix Liquida, Tar,—an empyreumatic oleo-resin. (See *ante*, page 215).
Oleum Picis Liquidæ, Oil of Tar,—soluble in alcohol.

Camphora, Camphor. (See page 117).
Linimentum Camphoræ, made with Cotton-seed Oil, 80 per cent.
Linimentum Saponis, Soap-liniment,—Soap 10, Camphor 5, Oil Rosemary 1, Alcohol 70, Water q. s. ad 100 parts.

Terebinthina, Turpentine. (See page 215).
Oleum Terebinthinæ, Oil of Turpentine, Spirits of Turpentine,—is soluble in 6 parts of alcohol. (See *ante*, page 215).
Linimentum Terebinthinæ, Turpentine Liniment,—has of the oil 35 parts with Resin Cerate 65,

Cantharis, Cantharides, Spanish Flies,—the beetle *Cantharis vesicatoria*, an insect of the order Coleoptera.

Tinctura Cantharidis, ♏ij–x. *Linimentum Cantharidis.*
Ceratum Cantharidis. *Ceratum Extracti Cantharidis.*
Charta Cantharidis. *Collodium cum Cantharide.*

The Liniment consists of Cantharis 15 parts, in 85 of Oleum Terebinthinæ, forming a preparation which is exceedingly unmanageable upon tender skins. Any of the other preparations are preferable.

Capsicum,—is the fruit of *Capsicum fastigiatum*, Cayenne pepper, a plant of the nat. ord. Solanaceæ, to which Belladonna, Stramonium, Hyoscyamus and Dulcamara also belong. Contains an alkaloid resembling coniïne in odor, and a very acrid and volatile principle, named *Capsaicin*. Is often adulterated with red lead when in powder.

Tinctura Capsici,—Dose, ♏v–ʒj. as a gargle ʒss–ij in ℥vj.
Oleoresina Capsici.
Extr. Capsici Fl., Dose, ♏j–x.
Emplastrum Capsici,—is a most excellent plaster.

***Menthol, Peppermint Camphor,** (B. P.),—a stearoptene obtained by cooling the oil distilled from the fresh herb of *Mentha arvensis* and of *Mentha piperita*. (See *ante*, page 192).

EPISPASTICS.

Epispastics (Vesicants),—*Cantharis* in some form is the agent in general use for blistering. (See page 222.) Other efficient epispastics are—

Mezereon.	Glacial Acetic Acid.
Euphorbium.	Volatile Oil of Mustard.

Confined Vapor of Ammonia.

PUSTULANTS.

Oleum Tiglii, Croton Oil,—(See *ante*, page 206).

Antimonii et Potassii Tartras, Tartar Emetic,—(See page 69).

Physiological Action. The action of irritants upon the circulation of an inflamed part is very similar to that of heat or cold, in that the result of either application is the relief of tension in the vessels, and consequently the relief of pain and decrease of inflammation. *Heat* acts directly, dilating the capillaries of the collateral circulation, and thereby diverting the current from the inflamed area. *Cold* acts indirectly, causing reflex contraction of the afferent vessels, and diminishing the supply of blood to the inflamed part. *Irritants* cause dilatation of the vessels of the part to which they are applied, but contraction of the vessels in other parts of the organism, especially in those parts or organs which have a nervous connection with the part or organ irritated. *Counterirritation* acts upon this principle, and to be most effectual, should not be applied directly over the organ inflamed, or even too near it, lest it should increase the congestion instead of diminishing it. (Brunton). By increasing the activity of the circulation in their immediate vicinity, counterirritants also promote the reabsorption of inflammatory products; and when employed for this purpose they should be applied directly over the organ or tissue affected. (Id.)

Therapeutics. Counterirritation, when intelligently employed in accordance with the above-mentioned principles, is an exceedingly efficient and valuable measure for (*a*) the relief of pain,—(*b*) the decrease of local inflammation,—and (*c*) the reabsorption of inflammatory products. Hence its applications are very numerous, and its area of employment a very wide one, admitting only the citation of a few instances to serve as illustrations. In—

Pericarditis,—a blister upon the thoracic wall, at some distance from the præcordia, will help to lessen congestion and consequently to lower the inflammation.

Pericardial Effusion,—to promote absorption, the blister should be placed directly over the præcordia.

Pneumonia,—to promote reabsorption after consolidation, a blister directly over the affected part, or an energetic rubefacient.

Neuralgia, of superficial nerves,—may be controlled by blisters over the painful nerve;—or over the spinal column at the "tender point" corresponding to the intercostal nerve affected;—or to the heel in sciatica. The actual cautery often still more efficient.

Vomiting from any cause,—is always helped by a blister or a rubefacient application over the epigastrium.

Chronic Ulcers,—vesicants locally, about the site of the ulcer, have a curative influence.

Joint Effusions, or thickening,—the only treatment of any value is by vesicants or the actual cautery.

Acute Rheumatism,—blisters around the joints are of great value not only for the local inflammation, but also for the general disease, upon which they have a curative influence.

Chronic Bronchitis and Pleurisy,—pustulants over the chest, in order to keep up a continuous moderate irritation.

EMOLLIENTS AND DEMULCENTS.

Petrolatum, Vaseline,—is a semi-solid substance, consisting of hydrocarbons, chiefly of the marsh-gas series, $C_{16}H_{34}$, etc.,—obtained by distilling off the lighter and more volatile portions from American petroleum, and purifying the residue. Melting point about 104° F. to 125° F., the first constituting the softer, and the second the firmer variety. Insoluble in water, scarcely so in alcohol, but soluble in boiling alcohol, ether, chloroform, oils, etc.

Paraffinum Durum, *Hard Paraffin,*—and **Paraffinum Molle,** *Soft Paraffin,*—are the corresponding B. P. preparations; the former melting at 110° to 145° F., and the latter at 95° to 105° F., or somewhat higher. Both forms are officially directed to be used as the bases of the British pharmacopœial ointments.

***Icthyol,**—see *ante,* page 71, under the title SULPHUR.

Mel, Honey,—is a saccharine secretion deposited in the honey-comb, by *Apis mellifica,* the honey bee, an insect of the order Hymenoptera. Honey consists of a strong aqueous solution of mixed dextrose and levulose, the sum of which, known as "glucose" amounts generally to 70 to 80 per cent.

Mel Despumatum, Clarified Honey,—warmed and strained.

Confectio Rosæ,—has 12 per cent. of Clarified Honey.

Mel Rosæ,—has 92 per cent. of Clarified Honey.

**Oxymel* (B. P.),—Honey 40, Acetic Acid 5, Water 5.

Linum, Flaxseed, Linseed,—the seed of *Linum usitatissimum*, Flax, a cultivated plant of the nat. ord. Lineæ. Contains much mucilage in the covering of the seeds, and in the seed itself one-third by weight is the oil, *Oleum Lini*, Flaxseed or Linseed Oil, which is obtained by expression without the use of heat. *Linseed-meal* is the powdered cake, remaining after the oil has been expressed.

Oleum Lini, Linseed Oil, (See *ante*, page 50)—Dose, ad libitum.

**Infusum Lini*, Linseed or Flaxseed Tea, (B. P.),—has of Linseed 150 grains, Liquorice-root 50 grains, infused in 10 ounces of boiling water for 2 hours, and strained.

*Lanolin, See page 50, *ante*, under OILS AND FATS, where also Cod-liver Oil, Cotton-seed Oil, Cacao-butter, and many others.

Physiological Action and Therapeutics. The substances, of which the above are only a few examples, have a medicinal action which is chiefly mechanical, forming a smooth and soft coating to an inflamed mucous membrane or to a portion of the skin denuded of its epidermis, protecting it from irritation by the air, and permitting the processes of repair to proceed unchecked by any external interference. Some of them, in addition, soften and relax the tissues (emollients), thereby lessening tension, and consequently relieving pain. *Flaxseed* is the favorite material for *poultices*, which are simply local baths, conveying heat and moisture to the part. It has the additional quality of being emollient, due to its mucilaginous and oleaginous constituents; and hence is one of the most efficient agents of the class to which it belongs. *Linseed Oil* is frequently applied to burns, scalds, eczematous eruptions, etc., either by itself, or with lime-water, as in the old-fashioned "Carron Oil," now replaced by Linimentum Calcis. Internally, in doses of ℥ij morning and evening, it has been highly spoken of as a cure for hemorrhoids. *Honey* is chiefly used as a vehicle, and as an ingredient of gargles. It is laxative in full doses. The mixture of honey and vinegar, official in the B. P. as *Oxymel*, is a favorite remedy for colds and sore throats. *Petrolatum*, known commercially as Cosmoline, Vaseline, etc., is a valuable protective, and an excellent basis for ointments, having no acridity, and no liability to turn rancid. It mixes readily with the alkaloids, the phenol compounds, and many other active agents; but it does not penetrate the skin as readily as animal fats and fixed oils, (for which see page 50, *ante*.)

MEMORANDA ON NEW REMEDIES

and others not mentioned in the preceding pages.

***Adonis Vernalis**,—is a plant of the nat. ord. Ranunculaceæ, (which contains Aconite, Pulsatilla, Podophyllum, etc.). It contains a glucoside named *Adonidin*, which acts almost exactly like Digitalin, but is much more powerful, and without any cumulative property. It has been used largely in Europe for cardiac failure due to organic lesion, but is thought to be less certainly beneficial in valvular disease than Digitalis. Besides its power as a cardiac tonic, it is also diuretic, and is very liable to produce vomiting and diarrhœa. The Infusion (ʒ ss–ij of the root to ℥ vj of water) may be given in doses of ℥ ss every 2–4 hours, or Adonidin itself, in doses of gr. ⅓, four to six times daily.

***Boldo**,—the leaves and stems of *Peumus boldo*, a Chilian shrub. It is chiefly used as a substitute for quinine, and as a tonic for cases of chronic hepatic torpor. In S. America it is used for gonorrhœa and chronic cystitis. Dose of tincture (⅛) ♏x–xx.

***Cascara Amarga**, Honduras bark,—is the bark of a Mexican tree used as an alterative in syphilis and various skin affections. The use of tobacco and alcohol is said to counteract its usefulness. Dose of the fluid extract, ℥ ss–j.

***Cereus**, (*Cactus Grandiflorus*,)—is highly recommended in functional disorders of the heart, and in cardiac dyspnœa. Dose of fluid extract, gtt. x–xx.

***Chaulmoogra Oil**, from seeds of *Gynocardia odorata*,—is credited with a few cures of leprosy, and is recommended as an external application in scaly eczema, psoriasis, syphilitic skin diseases, chronic rheumatism, rheumatic arthritis and tabes mesenterica. Dose, gtt. v–x, in capsules, or *Gynocardic Acid*, which is less nauseous, in doses of gr. ss–iij.

Chrysarobinum, Chrysarobin,—is a mixture of proximate principles extracted from *Goa-powder*, a substance found in cavities of decay in the trunk of *Andira Araroba*, a Brazilian tree of the nat. ord. Leguminosæ. It is often improperly named "Chrysophanic Acid," and, used locally, it produces diffuse dermatitis, often followed by follicular and furuncular inflammation. It is a useful application in psoriasis and vegetable parasitic diseases, but should not be used over a large surface at one time.

Unguentum Chrysarobini,—strength 10 per cent.

***Drumine**,—is a local anæsthetic obtained from an Australian plant, the *Euphorbium Drummondii*. It seems to affect sensation wholly, having no effect upon the motor system, as does Cocaine, and other similarly acting agents. It has no effect upon the pupil, and is not toxic so far as yet known. Dose, and uses,—are similar to those of Cocaine. (See *ante*, page 124).

* **Erythrophlœum**, Casca Bark, Sassy Bark, Ordeal Bark,—is the bark of *Erythrophlœum Guinense*, an African tree of the nat. ord. Leguminosæ; used by the negroes as an ordeal in witchcraft trials. When used in quantity, it causes severe cephalalgia, nausea and vomiting, narcosis and death. It is used in Africa as a remedy for intermittents, dysentery and colic;—and in England it is believed to resemble Digitalis in its action on both the circulation and the renal secretion. It contains an alkaloid, *Erythrophlœine*, which seems to combine the properties of both Digitalin and Picrotoxin, causing convulsions like the latter agent. It has been used with benefit in dilated heart, and in mitral disease and dropsy. Dose, of the tincture (1 in 10), ♏v–x.

* **Fuchsine**, Magenta, Hydrochlorate of Rosaniline,—is an aniline dye occurring in brilliant crystals with a green lustre, and is said to have a remarkable influence in albuminuria with œdema, diminishing the quantity of albumen in all cases, and arresting it entirely in many. Dose, gr. j-iij thrice daily, in pill. Full doses have produced salivation, vomiting, diarrhœa, etc., and when thrown into the veins it has caused tremor, staggering gait, albuminuria, and even fatty degeneration of the kidneys,—symptoms possibly due to the presence of arsenic or aniline as impurities.

* **Jequirity**,—the seeds of *Abrus precatorius*, an Indian plant of the nat. ord. Leguminosæ, which are made into a lotion by macerating 155 grains of them in powder in 17 fluid ounces of cold water, and filtering. It rapidly produces a purulent or croupous conjunctivitis, in severity proportionate to the number of applications, which, on subsiding, is found to have destroyed old granulations, and other formations, as pannus, corneal ulcers, etc. The seeds are very poisonous, and their application to the eye is a dangerous procedure, the resulting inflammation being often incontrollable.

* **Lippia Mexicana**,—is recommended as a sedative expectorant in various bronchial affections, especially in coughs due to catarrhal inflammation of the respiratory passages. It is a creeping shrub of the nat. ord. Verbenaceæ, and contains a volatile oil named *Lippiol*. Dose, of the tincture, ʒ ss–j.

* **Myrtus Chekan**, a Chilian plant;—is recommended as an expectorant in bronchitis, winter cough, etc., also in chronic cystitis and catarrhal affections of other mucous membranes. Dose, of the fluid extract, ʒj–℥ss.

* **Piscidia Erythrina,** Jamaica Dogwood,—has been introduced as a substitute for Opium, being anodyne, hypnotic and narcotic, sialogogue, diaphoretic and mydriatic. It lowers reflex action, and arterial tension after a brief rise, weakens the heart and causes death by asphyxia. It is a good hypnotic and anodyne. Dose, of the fluid extract, ʒss–j, cautiously.

* **Tonga,**—is a preparation imported from Figi, consisting of root-fibres, leaves and inner bark of some plants, believed to be *Raphidophora vitiensis*, and *Premna tatiensis*. From this a liquid is prepared which has proved very efficient in ʒj doses ter die, for neuralgia.

* **Verbascum Thapsus,** Mullein Plant,—is being highly praised as a substitute for Cod-liver Oil in phthisis and other wasting diseases. It is used in infusion, ℥iv of the fresh leaves in a pint of fresh milk, thrice daily.

* **Yerba Santa,** (*Eriodyction glutinosum,*)—is a Californian shrub of the nat. ord. Hydrophyllaceæ, where it is a well-known expectorant, and usefully employed in bronchial and laryngeal disorders. It is said to cover the taste of Quinine in a remarkable manner. Dose, of the fluid extract, ℥ss–j; of an elixir or Syrup, ℥j–ij. When employed as a vehicle for the cinchona alkaloids, about ℥j is necessary for each 10 or 15 grains.

PRESCRIPTION-WRITING.

Extemporaneous Prescriptions are formulæ written by the physician on the instant (*ex tempore*), to meet the requirements of individual cases. A prescription has four component parts, viz.—the

Superscription,—which consists of the name of the party for whom it is designed, the date, and the sign ℞—signifying "Take," or "Take thou."

Inscription,—the body of the prescription, consisting of one or more of the following subdivisions, viz.—the

Basis, or chief ingredient.

Adjuvant, to assist the action of the basis.

Corrective, to correct some injurious quality of the other ingredients.

Vehicle or Excipient, to give it form.

Subscription,—the directions for the compounder, usually expressed in contracted Latin.

Signature,—the instructions for the administration of the medicine, expressed in English or Latin, and followed by the signature of the prescriber.

A prescription may, however, contain the basis alone, or the basis with the adjuvant, or the basis with a simple vehicle or diluent. A single ingredient may serve a double or a treble office, as the Aromatic Syrup of Rhubarb with Quinine, in which the syrup serves as an adjuvant to increase the action of the quinine, as an excipient to cover the taste, and as a vehicle to facilitate the administration of the dose directed. Again, the basis may need no aid in doing its work, and may require no corrective of its action, nor any special vehicle. On the other hand, there is no limit to the number of ingredients which may be used, provided that the prescriber has a clear idea of something to be accomplished by each one, and also provided that there is no chemical or medicinal incompatibility between them. Formerly prescriptions were very complex, and contained a great many curious and incongruous ingredients. As Dr. Phillips well says, "the tendency of the present age is toward mono- rather than poly-pharmacy, and prescriptions with the orthodox *adjuvans* and *corrigens* are less frequently seen than formerly." There is danger, however, in carrying this simplicity too far, for there is no doubt but that proper combinations of medicines will often produce effects for the patient's good, which could not be obtained from the use of any one remedy.

Procedure in Writing a Prescription. The first step is to write the name of the patient, the date, and the sign ℞. Then the title of each ingredient should be written in Latin and in the genitive case, except when only a certain number of an ingredient is to be used, the ingredient should be in the accusative case, as for example, "*Vitellum unum*,—one Yolk-of-egg." Next the quantity of each ingredient sufficient for one dose should be mentally determined, and multiplied by the number of doses which the mixture, etc., is to contain, and the result set down in signs and Roman numerals opposite the designation of each article. Directions to the pharmaceutist and for the patient being added, and the prescriber's name or initials being affixed, the prescription is completed. Frequently, the ingredients and their quantities for but one dose, in pill, powder, suppository, etc., are named, with instructions to make a certain number after the formula prescribed. When an unusually large dose of any poisonous drug is prescribed, it is customary to underline the quantity, so as to call the attention of the compounder to the fact that the large dose is ordered intentionally.

An Example will perhaps make the foregoing more comprehensible, and at the same time serve to indicate the style of writing usually employed. The following formula is that ordered in the U. S. Pharmacopœia for the preparation known as "*Black Draught*," but officially styled the *Compound Infusion of Senna;* approximate weights and measures being substituted for the pharmacopœial parts by weight.

For Mrs. Gray. *July 7th, 1886.* } SUPERSCRIPTION.
Recipe, Take,—
(Basis.) { *Sennæ, semiunciam,*
Of Senna, half an ounce,
Magnesii Sulphatis,
Of Magnesium Sulphate,
(Adjuvant.) { *Mannæ, ana unciam unam,*
Manna, of each an ounce.
(Corrective.) { *Fœniculi, drachmam unam,*
Of Fennel, one drachm,
(Vehicle.) { *Aquæ Bullientis, fluiduncias octo,*
Of Boiling Water, eight fluid-ounces. } INSCRIPTION.
Macera per horam in vase clauso, deinde cola.
Macerate for an hour in a closed vessel, then strain. } SUBSCRIPTION.
Signa,—Mark or Write, thus—*A wineglassful every four hours 'till it operates.*
T. F. Wood, M. D. } SIGNATURE.

Abbreviated in the style usual among physicians, the above prescription would read as follows, viz.—

For Mrs. Gray. *July 7th, 1886.*
℞. *Sennæ*.. ℥ss.
Magnesii Sulph
Mannæ..aa ℥j.
Fœniculi.. ʒj.
Aquæ Bull..f℥viij.
Mac. per hor. in vase clauso, deinde cola.
Sig.—A wineglassful every four hours, 'till it operates.
Wood.

As the result of the above is nearly identical with the official preparation, we might write the same prescription more simply, as follows,—

℞. *Infusi Sennæ Compos.*, ℥viij.

with the proper superscription and signature; this being the manner of prescribing the official preparations.

It will be noticed that in the above analysis the term "basis" covers two ingredients; but it is obvious that either of them might be considered the principal agent, and the other one classed as an adjuvant.

"These four parts of a formula are intended to accomplish the object of Asclepiades, *curare cito, tute et jucunde;* in other words, to enable the basis to cure quickly, safely and pleasantly." (Pareira.)

Another Example will illustrate the mental operations which should always be followed by a prescriber; for no matter how good a memory he may have, he will surely make a grievous mistake some day if he follow the practice of writing prescriptions from memory Furthermore, the unscientific character of the latter habit will, when appreciated, prevent any educated physician from indulging in it. Every prescription should be written with a definite purpose in view, consequently the mind of the prescriber should weigh each step carefully, and should avoid all slavish subjection to ready-made formulæ.

Suppose, then, that we wish to order for Miss Graham an emulsion of Castor Oil, flavored and sweetened so as to make it less disagreeable to the taste than it naturally is. If the ingredients were simply mixed together, as in the previous example, the result would be an unsightly preparation, consisting of sweetened and flavored water with the oil floating on top. So we require that the process of emulsification be first accomplished, by which the oil is minutely subdivided and suspended in the water, by the aid of the emulsifier, which may be any viscid excipient, as gum, soap, or yolk-of-egg. Taking the last-named for the emulsifying agent, we would begin by writing down in order the following terms, as stated in italics, viz.—

For Miss Graham. *June 10th, 1886.*
℞. (Take thou—)
Olei Ricini, (of Oil of Castor),
Vitellum, (Yolk-of-egg),
Tere bene simul: dein adde—Rub well together; then add—)

Having gone so far, we begin to think of an agreeable vehicle, and choosing from the many Syrups at our disposal that of Ginger, and from the flavored Waters that of Cinnamon, we write further for these as the ingredients to be added, thus—

Syrupi Zingiberis, (of Syrup of Ginger),
Aquæ Cinnamomi, (of Cinnamon-Water).

The ingredients are now all entered upon the prescription, but their respective quantities have not yet been decided on. We proceed, then, by first taking into consideration the total quantity of the medicament required,—which, in this case, as the preparation is intended to purge the patient, need not embrace more than one or two doses. As it is well to provide for a repetition of the dose, in case the medicine should not act sufficiently, we will decide upon two doses in all. Now, the average adult dose of Castor-oil is about a tablespoonful, or half-an-ounce, and as we want two such doses we insert the sign and numeral f℥j, or simply ℥j, opposite the title of the oil, which is written in the genitive case. But to emulsify it properly we need about one-half as much of the emulsifying agent, and we may express this by writing for half an-ounce of yolk-of-egg, or for the yolk of one egg, or for one yolk-of-egg, which weighs about half-an-ounce. This would be expressed in Latin by either of the following methods, viz.—

Vitelli semi-unciam, (℥ss). One half-ounce of Yolk-of-egg.
Vitellum ovi unius, (j). The Yolk of one egg.
Vitellum unum, (j). One Yolk-of-egg.

As the word *Vitellus* means Yolk-of-egg, we may omit the word *Ovi*, and accepting the latter as the best style, insert the numeral j opposite the word *Vitellum*, which is properly in the accusative case. The whole quantity so far specified is one ounce and a half, and if we add two and a half ounces of diluent, we shall have a four-ounce mixture, or the full of a regular sized bottle, as found in the shops. There being considerable viscidity already present in the emulsion we do not need much syrup, so we assign to the Syrup of Ginger the odd half-ounce, leaving two ounces of the Water to make up the total bulk of four fluid-ounces.

The prescription now only requires for its completion that the subscription and signature be added. We proceed to admonish the dispenser by telling him to mix the ingredients together, and therefore write the word "*misce*," or the abbreviation "*M*" commonly used therefor; and to further point out the nature of the preparation we add, "*let be made an emulsion*," or in Latin, "*fiat emulsio*,"—the passive verb taking as predicate-nominative the thing into which the making is to be. The final words "*Label*"—or "*Write thus*"—are expressed by the term "*Signa*,"—followed by the directions for the patient or the person who is to administer the medicine, which should be in English, though they may also be written in Latin. Our completed prescription will stand thus,—

For Miss Graham. *June 10th, 1886.*
℞. *Olei Ricini*....................................℥j.
Vitellum.......................................j.
Tere bene simul, dein adde—
Syrupi Zingiberis..............................℥ss.
Aquæ Cinnamomi.............................℥ij.
M. fiat emulsio.
Sig.—" One-half at once, to be repeated next day if required."
Potter.

The last entry of the inscription might also be written thus,—"*Aqua Cinnamomi, quantum sufficiat ad* ℥iv," meaning "of Cinnamon-Water as much as may be necessary to [bring the whole quantity to] four ounces,"—usually expressed in contracted style, thus—

Aq. Cinnamomi, q. s. ad ℥iv.

This style is preferred when any of the quantities are approximations, and the final item cannot be exactly stated to secure a certain total. In the foregoing case, the one yolk-of-egg might measure a little more than the half-ounce assigned to it; but by using the *q. s. ad* style at the end, we make sure of getting a total of exactly four fluid-ounces.

In more complicated prescriptions, the mode of reasoning is precisely the same; practice, care, and knowledge of the whole subject being necessary to the production of those elegant prescriptions which are correctly termed "magistral," as the work of a *magister*, or master of his business.

Metric Prescriptions are written or read with sufficient accuracy, by considering a gramme as equal to 15 Troy grains, and a cubic centimeter (or milliliter) as being equal to 15 minims or one-fourth of a fluid-drachm. All other terms, units or prefixes, belonging to the metric system, may be wholly ignored by both physician and pharmacist. The decimal point after the gramme or the cubic centimeter should always be replaced by a line, so as to avoid errors, which in many cases might prove serious, from the misplacement of a point, the dropping of an ink-spot, or the intrusion of a fly-speck.

The simplest method of writing a prescription in metric terms, is to first write for one dose of each ingredient in grains and minims, then by substituting the same number of grammes and cubic centimeters (fluid-grammes), we get fifteen doses in metric terms. For example,—

		One Dose.	15 Doses Metric.	
℞.	Quininæ Sulphatis,	gr. j	1	
	Strychninæ Sulphatis,	gr. $\frac{1}{64}$ or 0.016		016
	Ext. Glycyrrhizæ Fl.,	♏iv	4	
	Syrupi,	♏lx	60	

This gives a two ounce-mixture approximately, of which the dose would be "a teaspoonful thrice daily."

The above rule will answer for all liquids except those which are very heavy (as Syrups and Chloroform), or very light (as Ether). Measures may be entirely discarded and all fluid quantities expressed in grammes. The average drop of water may be taken as equal to 0.05 c.c., the teaspoonful to 5 c.c , the tablespoonful to 20 c.c., the ℥ to 30 c.c. (or grammes), and ℥viij to 250 c.c.

Abbreviations are in general use in prescription writing, but should be avoided as much as possible. Their lavish use is a sign of the prescriber's ignorance of Latin, they confound the compounder, enhance the chances for error, and are therefore a frequent source of danger to the patient. In the larger works on pharmacy, very full lists of the commonly used abbreviations are given. The following table gives a few examples of the dangers of carelessness in their employment.

Aconit.—may mean either Aconitum or Aconitina.
Ammon.—Ammonia or Ammoniacum.
Ac. Hydroc.—Acidum Hydrochloricum or Acidum Hydrocyanicum.
Aq Font.—might easily be read Aqua Fortis.
Chlor.—Chlorum, Chloral, or Chloroformum.
Hyd. Chlor.—Hydrate of Chloral, Hydrargyri Chloridum.
Sulph.—Sulphur, Sulphas, Sulphidum, Sulphitum.
Zinc. Phos.—Zinci Phosphas or Zinci Phosphidum.

Latinizing a prescription correctly requires a very limited knowledge of the Latin language, yet that little is too often absent from the education of would-be doctors of medicine. Within the small space which can be allotted to this portion of the subject in these pages, it is impossible to offer more than a few notes to guide the student at first. For full treatment of the subject the reader is referred to Pareira's Prescription Book, which deals fully with every detail.

Genitive Case-Endings.

NOM.	GEN.	EXCEPTIONS.
a	æ	Cataplasma, Enema, Physostigma, Aspidosperma and Gargarysma, all have the genitive in *-atis*. Coca † is unchanged. Folia is plural, gen. Foliorum.
us um os on	i	Rhus, Rhois; Flos, Floris; Bos, Bovis; Limon, Limonis; Erigeron, -ontis. Fructus, Cornus, Quercus, Spiritus, Haustus, Potus, do not change.
as	atis	Asclepias, -adis; Mas, Maris.
is	idis	Pulvis, -eris; Arsenis, -itis, Phosphis, -itis, Sulphis, -itis, and all salts ending in -is, have genitive in -itis.
o	onis	Mucilago, -inis; Ustilago, -inis; Solidago, -inis.
l	lis	Fel, Fellis; Mell, Mellis; Sumbul, Sumbuli.
en ps rs r x	inis pis rtis ris cis	*Words which do not change in the Genitive.* *Amyl. Catechu. Digitalis. Kino. Azedarach. Coca.† Fructus. Matico. Berberis. Cundurango. Haustus Quercus. Buchu. Cornus. Hydrastis. Sassafras. Cannabis. Curare. Jaborandi. Sago. Sinapis. Potus. Spiritus.

* Amylis, is given. † Cocæ, is given.

VERBS.

The Verbs used in prescription-writing are nearly all in the imperative mood, giving directions to the compounder, and having their object in the accusative case. Such are—

Adde, add.
Cola, strain.
Divide, divide.
Extende, spread.
Fac, make.
Filtra, filter.
Macera, macerate.
Misce, mix.
Recipe, take.
Signa, write.
Solve, dissolve.
Tere, rub.

A few verbs are found in the subjunctive mood, taking their subject or predicate in the nominative case. The most usual are—

Fiat, let be made.
Fiant, let be made.
Coletur, let be strained.
Coloretur, let be colored.
Sumatur, let be taken.
Bulliat, let boil.
Capiat, let take.
Detur, let be given.
Dividatur, let be divided.
Sit, let it be.

PARTICIPLES.

Participles or Verbal Adjectives, are occasionally used, and should agree with their respective nouns in gender, number and case. Such are the following, viz.—

Dividendus, -a, -um, to be divided.
Sumendus, -a -um, to be taken.
Adhibendus, -a, -um, to be administered.

PREPOSITIONS.

Those in the first column require the noun following to be in the accusative case,—those in the second column require the ablative case.

Ad, to, up to.	*Cum*, with.
In, into.	*Pro*, for.
Supra, upon.	*Sine*, without.

Ana, of each,—governs the genitive case.

SUNDRY WORDS AND PHRASES.

Bene, well.
Bis, twice.
Dein, thereupon.
Et, and.
Gradatim, gradually.
Guttatim, by drops.
In dies, daily.
Da, give.
Non, not.
Numerus, number.
Octarius, a pint.
Semel, once.
Simul, together.
Statim, at once.
Ter, thrice.
Quater, four times.
Ad saturandum, to saturation.
Numero, to the number of.
Quantum sufficiat, as much as necessary.
Pro re natâ, according to need.
In partes æquales, into equal parts.
Redactus in pulverem, let be pulverized.
Secundum artem, according to art.
Non Repetatur, let it not be repeated.

Principles of Combination include certain maxims which should never be lost sight of. To prescribe as few remedies as possible, and to order no powerful drug without a distinct idea of its office in the prescription, are, perhaps, the chief; to which may be added another, namely—to give powerful agents by themselves when required for impression on the system.

Medicines are combined for several purposes,—(1), to increase, correct or modify the action of another medicine; (2), to obtain the joint action of two or more diverse remedies; (3), to obtain by chemical reaction a special combination, which is either a new remedy, or which acts as a new remedy; (4), to give a suitable form for administration, or for preservation.

Incompatibility may be Chemical, Pharmaceutical or Therapeutical, according as the incompatible combination results in chemical decomposition, physical disassociation, or antagonistic physiological action. The first kind may be intentional, for the purpose of obtaining a new substance as the result of the chemical action;—for example, the prescribing Calomel or Corrosive Sublimate with Limewater, to produce respectively the black and yellow Oxides of Mercury.

The Dangers of Incompatibility may in a great measure be avoided by the use of the utmost simplicity in prescribing. The subject can only be glanced at within these pages, but the following simple rules may help the burdened memory of the student and the practitioner.

(1). Never use more than one remedy at a time, if one will serve the purpose.

(2). Never use *Strong Mineral Acids* with other agents, unless you know exactly what reaction will ensue. They decompose salts of the weaker acids, and form ethers when combined with alcohol. Never combine *free acids* with hydrates or carbonates.

(3). Select the simplest solvent, diluent or excipient you know of, remembering that the solvent power of alcohol and of water for their respective substances decreases in proportion to the quantity of the other added.

(4). Generally do not combine two or more soluble salts; for such salts in solution, when brought together, usually exchange their radicles, thereby forming an insoluble compound.

The following more or less insoluble salts will be formed whenever the materials of which they are composed are brought together in solutions; the Hydrates, Carbonates, Phosphates, Borates, Arseniates and Tannates of most earthy and heavy metals and alkaloids, and the metallic Sulphides; the Sulphates of Calcium, of Lead, and the subsalts of Mercury; the Chlorides, Iodides, and Bromides of Bismuth, Silver, Lead, and Mercury; the Iodides of Quinine, Morphine and most alkaloids.

(5). Never order a drug in combination with any of its Tests or Antidotes.

(6). Never prescribe a *Glucoside*, (as Santonin, Colocynthin, etc.), in combination with *free acids* or with a substance containing *Emulsin*, as these agents will decompose it.

(7). *Aconite* should be ordered in water alone, *Mercuric Chloride* by itself in water or in simple syrup. The latter drug is incompatible with almost everything, even the Compound Syrup of Sarsaparilla being said to decompose it.

(8). *Iodide of Potassium* decomposes most of the metallic salts, and is one of the drugs which are best administered alone.

(9). *Resinous Tinctures or Fluid Extracts*, (*e.g.*, Tinct. Cannabis Indicæ) when combined with aqueous solutions, should always have Acacia or some other emulsifying agent added, to prevent the separation of the resin, which otherwise will be deposited on the sides of the bottle or will float on top of the mixture.

(10). *Silver Nitrate* and the *Acetate* and *Sub-acetate of Lead*, though incompatible with almost everything, may be combined with *Opium*, the latter forming with Opium a compound, which, though insoluble, is therapeutically active as an astringent and anodyne lotion. *Silver Nitrate* with *Creasote* forms an explosive compound.

(11). *Tannic and Gallic Acids*, and substances containing them (as the Astringent Bitters), precipitate albumen, alkaloids and most soluble metallic salts. They may be prescribed with the proto-salts of Iron, but not with its per-salts. *Calumba* is the best vegetable tonic to use with ferric salts, as it contains neither tannic nor gallic acids. *Tannic Acid* precipitates gelatin.

(12). *Iodine* and the soluble *Iodides* are incompatible with the alkaloids and substances containing them, also with most metallic salts.

(13). *Alkalies* neutralize free acids, and precipitate the alkaloids and the soluble non-alkaline metallic salts. *Oxides of the Alkalies* decompose salts of the metals proper, and salts of the alkaloids, precipitating their bases; but the base may be soluble in an excess of the alkali.

(14). *Poisonous Compounds* may be formed by the admixture of several substances in solution, such as—

Potassium Iodide or the Syrup of the Iodide of Iron,—with Potassium Chlorate.
Potassium Cyanide or Dilute Hydrocyanic Acid, with Calomel, Bismuth salts, metallic hydrates, carbonates subnitrates or subchlorides, forming poisonous cyanides.

(15). *Explosive Compounds* result from mixing powerful oxidizing agents with others which are readily oxidizable. The chief members of these two classes are as follows—

Oxidizers.	*Oxidizable or Combustible.*
Nitric Acid. Chromic Acid.	Glycerin, Sugar, Alcohols.
Free Hydrochloric Acid.	Oils and Ethers.
Nitro-hydrochloric Acid.	Sulphur and Sulphides.
Potassium Chlorate.	Dry Organic Substances.
Potassium Permanganate.	Phosphorus.

Instances of Pharmaceutical Incompatibility.

Resinous tinctures or fluid extracts with Aqueous solutions.
Tincture of Guaiac with Spirit of Nitric Ether.
Compound Infusion of Gentian with Infusion of Wild Cherry.
Compound Infusion of Cinchona with Compound Infusion of Gentian.
Essential oils with Aqueous liquids in quantities exceeding 1 drop to ℥j.
Fixed oils and Copaiba with Aqueous liquids (except excipients).
Tinctures made with Alcohol with those made with Diluted Alcohol.
Alcoholic tinctures and fluid extracts with Aqueous preparations.
Spirit of Nitric Ether with strong Mucilages.
Infusions generally with Metallic salts.

PRECIPITANT SOLUTIONS.

The following table shows the most important instances of solutions which mutually precipitate each other, the letter P meaning "forms a precipitate with"—

Table of some Mutually Precipitant Solutions.	Alkaloidal Solutions (generally).	Metallic Solutions (generally).	Lead Solutions.	Silver Solutions.	Calcium Solutions.	Magnesium Solutions.	Albuminous Solutions.	Gelatinous Solutions.
Solutions of Alkalies	P	P	P	P	P	P	......	......
Tannic Acid	P	P	P	P	......	......	P	P
Carbonic Acid and Sol. of Carbonates	P	P	P	P	P	P	......	......
Sulphuric Acid and Sol. of Sulphates	......	......	P	P	P	......	......	......
Phosph'c Acid and Sol. of Phosphates	P	P	P	P	P	P	......	......
Boric Acid and Solutions of Borates	P	P	P	P	......	......	......	......
Hydrochloric Acid and Sol. of Chlorides	......	......	P	P	......	......	......	......
Hydrobromic Acid and Sol. of Bromides	......	......	P	P	......	......	......	......
Hydriodic Acid and Solutions of Iodides	P	......	P	P	......	......	......	......
Solutions of Sulphides	......	P	P	P	......	......	......	......
Arsenical Solutions	......	P	P	P	......	......	......	......
Albumen	......	P	P	P	......	......	......	......

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